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A Study of the

SOCIAL AND ECONOMIC IMPACT OF ODORS

Phase II

Final Report Prepared for the
ENVIRONMENTAL PROTECTION AGENCY

November 1971

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313

BIBLIOGRAPHIC DATA SHEET

1. Report No. APTD-0899

2.

3. Recipient's Accession No.

4. Title and Subtitle

A Study of the Social and Economic Impact of Odors - Phase II

5. Report Date November 1971

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

Copley International Corporation
7817 Herschel Avenue
La Jolla, California 92037

10. Project/Task/Work Unit No.

11. Contract/~~Grant~~ No. CPA 70-116

12. Sponsoring Organization Name and Address

Environmental Protection Agency

13. Type of Report & Period Covered Final

14.

15. Supplementary Notes DISCLAIMER: This report was furnished to the Environmental Protection Agency, in fulfillment of Contract No. CPA 70-116.

16. Abstracts

The results are presented of the second phase of research undertaken to establish air quality, performance and emission standards that specify what levels of odors are acceptable or how such levels should be determined. The ultimate objective of the research was the development of a method to assess the social and economic aspects of community odor problems. To accomplish this end the following tasks were undertaken: (1) a metropolitan area was selected from the list of 31 potential odor problem areas, Test areas were established near a variety of sources to permit a comparison of the effects of odors having vastly different qualities; (2) public attitude surveys and technical field studies were conducted simultaneously, The objective of the public attitude surveys was to obtain data relative to the influence of odors on the attitudes of residents. The technical field studies were to employ sensory techniques to systematically measure the intensity, duration, frequency and temporal variation of odors for correlation with the results of the quarterly surveys. (3) comprehensive analysis of social and economic effects of odors was conducted, particularly as reflected in residential property values; (4) a set of assessment procedures was prepared.

17. Key Words and Document Analysis. 17a. Descriptors

Air pollution	Assessments
Odors	
Standards	
Field tests	
Attitude surveys	
Public opinion	
Odor detection	
Odometers	
Economic analysis	
Residences	

17b. Identifiers/Open-Ended Terms

Air pollution detection
Air pollution effects (humans)
Air pollution effects (materials)

17c. COSATI Field/Group 13B

18. Availability Statement Unlimited

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 331

22. Price 7.75-0.95

FORM NTIS-35 (10-70)

USCOMM-DC 40329-P71

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Prepared for the

ENVIRONMENTAL PROTECTION AGENCY
Under Contract No. CPA 70-116

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ACKNOWLEDGMENTS

Copley International Corporation gratefully acknowledges the cooperation of many private citizens of the Los Angeles metropolitan area who gave generously of their time by participating in personal interviews. Without their wholehearted cooperation, this report would not have been possible.

Copley International Corporation is especially grateful to Mr. Richard C. Dickerson of the Environmental Protection Agency for his counsel and assistance in the development and conduct of the study, and to Dr. Donald G. Gillette and Mr. Norman A. Huey of the same Agency for their suggestions relating to the research.

The work upon which this report is based was performed pursuant to Contract No. CPA 70-116 with the Environmental Protection Agency.

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CHAPTER I

INTRODUCTION

Under the Air Quality Act of 1967 and the Clean Air Amendments of 1970, the federal government embarked on a program to amass information relating to the sources, effects, measurements, and controls of odors and other acknowleged air pollutants. This comprehensive effort will support the Environmental Protection Agency in drafting and promulgating a series of air quality, performance, and emission standards to be implemented at the state level. For the solution of countless community odor problems, it is deemed appropriate that the standards specify what levels of odors are acceptable or how such levels should be determined, particularly at ambient intensities.

Numerous studies have already been performed under this program, including the national survey of the odor problem, conducted in 1969, and the present study, conducted in 1970 and 1971. Both studies investigated methods of evaluating community odor problems and, together, yielded information toward the specifications alluded to above. Both studies were conducted by Copley International Corporation for the Environmental Protection Agency, under contracts CPA 22-69-50 and CPA 70-116.

NATIONAL SURVEY OF THE ODOR PROBLEM

Objectives and Methodology

The overall objective of this first phase of research was an assessment of the national odor problem based on the projections of the results of investigations in a selected sample of identified odor problem areas. Tasks leading to the achievement of this objective included:

(1) The identification and description of major odorants and odorant sources.

(2) A determination of the odor producing potential and the location of groupings of industrial odorant sources.

(3) The location of concentrations of population.

(4) A determination of the effects of the natural environment on odor problems and the identification of odor supporting atmospheric regions.

(5) A survey of all local air pollution control agencies in the United States.

(6) The selection of seven metropolitan areas for investigations of possible odor problems.

(7) A series of technical field investigations involving the use of sensory techniques.

(8) A series of public attitude surveys of residents and businessmen.

The presence of an odor problem is dependent upon the existence of an odorant source (or sources), an odor receptor population, and a mechanism to transport the former to the latter. Thus, in order to ultimately assess the national odor problem, it was necessary to identify areas throughout the United States with coincidence of high levels of three basic factors:

(1) Industrial odor producing potential, represented by the number of operating industrial plants weighted by relative size of plant and detectability of odorants produced.

(2) Potential extent of odor reception, represented by the size of the population affected.

(3) Atmospheric vulnerability, represented by a composite of the major causes of impaired atmospheric dilution capacity.

A sample of seven metropolitan areas was selected from a list of 31 found to rank high in these factors. The selection process took into consideration the need for nationwide representation of the study results and detailed information on likely odor problems solicited from the local air pollution control agencies. At least one problem community in each of the seven metropolitan areas was evaluated using scentometers to measure the intensity and areal extent of the odors detected. In Philadelphia, PA, an odor judgment panel was employed to determine intensity patterns of odors caused by two sources.

The public attitude surveys were conducted as an exploratory approach to determine the extent to which odors constitute an influence on the lives of people living and working in problem communities. The objectives were to determine if people are generally aware of odors in their communities, if the public is interested in the abatement of odors, if people believe they have suffered socially or economically because of odors, and if differences in opinion about odors exist between people living in odor affected (test) areas and those living in relatively odor free (control) areas.

Principal Findings of the National Survey

The principal findings of the first phase of research were drawn from the results of the technical field investigations and the surveys of local air pollution control agencies and public attitude.

Results of the Survey of Local Air Pollution Control Agencies. The responses received from the mail survey of 184 local air pollution control agencies in the United States indicated that odor problems existed in many cities and counties throughout the nation. It was further indicated that the odor problems, in general, affected a very large number of people.

Four categories of sources were responsible for almost half of the odor problems reported. These categories were: rendering/meat packing/slaughterhouses; chemical/plastic plants; sanitary land fill/dumps/open burning/incinerators; petroleum and natural gas refineries/asphalt plants. In contrast, the four categories reported to have the highest monthly average number of complaints were: sanitary land fill/dumps/open burning/incinerators; fisheries and fish canneries; rubber/tire plants; coffee roasting/spice processing plants. The responding agencies viewed chemical/plastic plants as the most serious odor sources and pulp/kraft/wood mills as the sources of the fastest growing problems.

The identification and assessment of community odor problems was accomplished by a large number of the reporting agencies using the unaided nose, common sense, and number of complaints as criteria. An equally large number of agencies reported that there are many inadequacies in such methods of assessment and expressed a need for assistance in establishing more effective procedures.

Over 70 percent of the responding agencies took some form of abatement action. One of the most popular forms of abatement was persuasion. The most frequently used legislation relating to odor abatement was state or local nuisance laws. Due to staff limitations at most agencies, as well as the general requirement that a considerable number of persons perceive an odor situation as a nuisance, nuisance laws have been ineffective in abating odors. To the extent this study could determine, none of the seven metropolitan areas visited had a record of substantial fine or other judicial penalty levied against an odor law violator.

Results of the Field Technical Program. The scentometer, a vapor dilution technique device, was found to provide rapid observations at fixed locations. From the viewpoint of monitoring low intensity odors, however, the scentometer seemed to lack the sensitivity of an unaided nose. Using the scentometer in each of the metropolitan areas visited, refinery installations and chemical facilities were found to be the most significant sources of odors in terms of areal extent.

The use of an odor judgment panel provided definitive descriptions of the areal extent and intensity patterns of odors caused by an oil refinery and an animal rendering plant. This technique was stated to have substantive application in those special circumstances where legal liability or compliance questions require explicit documentation of odorous emissions.

Results of the Public Attitude Surveys. The type of resident found in both the test and control areas was characterized as lower-middle class. He tended to be blue collar, middle aged or older, below average in education and income, and with family size lower than average.

Overall, the difference in attitudes between respondents in the test and control areas was that relating to air pollution. This difference was reflected consistently in the volunteered and solicited responses to a variety of questions. For example, air pollution was rated as a serious or somewhat serious problem by 65 percent of test area respondents, but only 36 percent of control area respondents.

Residents of both areas appeared most aware of odors in relation to air pollution. However, of five descriptions of air pollution (smoke or dust, noticeable odors, irritation of the eyes, nose and throat irritation, haze or fog), the largest difference of opinion between respondents in the test and control areas was that relating to noticeable odors. Specifically, "air pollution" meant noticeable odors to 82 percent of test area respondents, but only 67 percent of control area respondents. From the surveys, one may infer that odors have been rated as a serious or somewhat serious problem by about 50 percent of test area respondents, but only 25 percent of control area respondents.

It seemed that the respondents who stated that odors were a problem were only passively interested in the abatement of odors in their communities. To some extent, this passivity was due to an obvious lack of knowledge of the authorities to whom complaints must be directed. The respondents would approve of additional funds to abate odors in their communities on the condition that the funds would be supplied by offenders. Beyond this, they seemed resigned to tolerance of an odorized environment. Homeowners in the test and control areas who stated odors were a problem felt that odors had reduced the marketability of their property.

The owners and managers of a sample of commercial businesses in each test and control area were also interviewed. In general, the opinions of these businessmen supported those of the respondents. They were as aware of odors as the residents, but were less concerned.

Assessment of the National Odor Problem

The results of the study indicated that, although industrial odor producing potential exists in most metropolitan areas of the United States, the probability of encountering community odor problems is greatest in the urban portions of the Appalachian and Rocky Mountain Regions and the California Coastal Zone. Projecting the results of the attitude surveys to the nation as a whole suggested that as many as 25 million residents perceived community odors as problems.

SOCIAL AND ECONOMIC IMPACT OF ODORS

Objectives and Methodology

The ultimate objective of the second phase of research was the development of a method to assess the social and economic aspects of community odor problems. Tasks leading to this end included:

(1) The selection of a metropolitan area in which to conduct an in-depth study.

(2) A series of public attitude surveys to be conducted at quarterly intervals.

(3) A series of technical field studies to be conducted concurrently with the public attitude surveys.

(4) A comprehensive analysis of social and economic effects of odors, particularly as reflected in residential property values.

(5) The preparation of a set of assessment procedures.

As in the first phase, a metropolitan area was selected from the list of 31 potential odor problem areas. Test areas were established near a variety of sources to permit a comparison of the effects of odors having vastly different qualities.

The public attitude surveys and technical field studies were conducted in December 1970, March 1971, and June 1971. The objective of the public attitude surveys was to obtain data relative to the influence of odors on the attitudes of residents. Small sample sizes were used to determine whether the survey method could be used to obtain quick and decisive answers about the existence of a variety of possible odor problems.

The technical field studies were to employ sensory techniques to systematically measure the intensity, duration, frequency, and temporal variation of odors for correlation with the results of the quarterly surveys and to further compare the operational features of the techniques used in the Philadelphia investigation.

The assessment procedures were to provide step-by-step instructions for the evaluation of social and economic effects and to verify the sources and areal extent of odors detected in any community. Such procedures were prepared with the intent that they could be used by qualified state and local air quality agency personnel.

Principal Findings of the Present Study

The principal findings of the second phase of research resulted from the public attitude surveys, the technical field studies, the economic analyses of property value differentials, and the development of the assessment procedures.

Results of the Public Attitude Surveys. The residents interviewed were characterized as middle class. When questioned about odors, they tended to think only of unpleasant odors. In the test areas and matching control areas set up to study unpleasant odors, a sizeable proportion of respondents noticed odors; however, the percentage of test area respondents who reported noticing odors was significantly larger. A majority of residents who noticed odors were also bothered by them whether they lived in a test area or a control area. A sizeable percentage of residents who reported noticing odors felt that odors were a serious problem.

People were generally unaware of any adverse economic effects of odor problems, or they did not believe such effects existed. During the winter and spring surveys, a majority of respondents indicated they had not been forced indoors by odors, but in the summer more than half of the test area respondents said this had happened. Generally, people reported that odors had not made members of the family ill. Definition of the degree to which these problems had resulted in either adverse social or economic effects was generally beyond the capability of the respondents.

Results of the Technical Field Studies. Correlation of odor reference standards to the scentometer illustrated that the scentometer was improperly characterized as an insensitive device in the results of the national survey. Although the transiency of the odors encountered may render it insensitive at fixed stations, it was found quite adequate for discriminating among odor intensities from a mobile platform. Because it can be used to defatigue the operator when odors are of constant intensity and long duration, the scentometer may be a more sensitive technique than an odor judgment panel in such situations.

If odor judgment panel evaluations are to be used as a general means of enforcing odor regulations, a considerable amount of work is still necessary. Investigation of an odor problem at short notice may require the availability of a large number of reference standards. The stability of the standards over long periods needs investigation. Panel training and logistics require a few days before a panel can be deployed into the field. Because of the number of people involved, this becomes a lengthy and expensive procedure. The most efficient use of such evaluations is not as a tool for routine surveillance, but as a means for gathering substantial evidence against offenders who will not cooperate with local authorities. As was concluded in the first phase, this technique is particularly applicable to those circumstances where legal liability or compliance questions require explicit documentation of an odorous emission or absolute verification of an odor source.

Results of the Economic Analysis of Property Value Differentials. The average price of homes was found to have grown faster in the principal test area than in its matching control area for the 1968-1970 period when an odor problem existed in the test area. Three explanations were offered for this finding:

(1) The problem was too transitory to be capitalized into property values.

(2) The technique adopted was simply not sensitive enough to detect the small dollar effects likely in this particular study.

(3) Some other factor having an opposite effect than odors may have been present.

Since strong odors were present frequently in the test area beginning in 1969 and since no other factors were found to offset the effects of odors, the most plausible explanation is the insensitivity of the technique.

Results From the Development of the Assessment Procedures. It was planned that the national survey of the odor problem and the study of the social and economic impact of odors would provide a series of relationships that could be used in the development of federal standards regarding odors. Yet, as this and other research progressed, it became evident that the measurable reaction to a vast majority of odor problems was annoyance, not other social or economic effects. Thus, a general means for dealing with such problems must consider personal evaluations as central to success. In the application of public nuisance law, the evaluation of the normal person in the community must be considered. Public attitude surveys were recommended as the proper means for doing so.

To simplify the requirements for odor problem identification, consideration was given to the elimination of surveys in control areas. The best possibility of doing so was found by combining the results from the odor free control areas previously investigated. Preliminary attempts indicated that the same combined results could be used to reduce the effort required to survey test areas. This reduction of survey effort seems possible through sequential analysis under which one of three decisions can be made:

(1) That an odor problem is identified.

(2) That an odor problem does not exist.

(3) That the results are inconclusive and that an additional interview must be completed.

Copley International Corporation will give further consideration to these possibilities during a third phase of research to be conducted for the Environmental Protection Agency during 1972.

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Copley International Corporation. National Survey of the Odor Problem. Publication No. PB-194 376. Springfield, Virginia: U. S. Department of Commerce, National Technical Information Service, 1970.

Copley International Corporation. National Survey of the Odor Problem: Appendix. Publication No. PB-194 377. Springfield, Virginia: U. S. Department of Commerce, National Technical Information Service, 1970.

CHAPTER II

FIELD PROGRAM PREPARATION

A major outcome of the national survey of the odor problem was the identification of potential odor problem areas throughout the United States. Such areas were described in terms of the coincidence of high levels of the three basic factors mentioned in the previous chapter — industrial odor producing potential, potential extent of odor reception, and atmospheric vulnerability.

The field program of the first phase of research was conducted in the following metropolitan areas:

- Portland, OR
- Kansas City, MO
- Cincinnati, OH
- Buffalo, NY
- Philadelphia, PA
- Tampa, FL
- San Francisco, CA

These locations were chosen to represent 31 potential odor problem areas identified in all regions of the United States (Table 1).

The present study was to be conducted in a single metropolitan area as representative as possible of all those listed in Table 1. The diversification of industrial source, the socioeconomic characteristics of the population, and the features of the natural environment were all considered in making this important choice. The first section of this chapter discusses the selection of Los Angeles, CA. The second and third sections describe the sources of odors and the delineation of the test areas. The location of comparable control areas is also covered in the third section. The final section portrays the natural conditions encountered during the field activities.

SELECTION OF A METROPOLITAN AREA

Selection Criteria

A metropolitan area was to be selected in which at least two communities were known to be affected by odors of industrial origin. These existing situations

Table 1. Thirty-one potential odor problem areas identified during the national survey of the odor problem, by U. S. Census Region.

Northeast	North Central
Boston, MA Buffalo, NY Newark, NJ New Haven, CT New York, NY Philadelphia, PA - Camden, NJ Pittsburgh, PA Providence, RI	Chicago, IL Cincinnati, OH Cleveland, OH Columbus, OH Dayton, OH Detroit, MI Indianapolis, IN Kansas City, KS - Kansas City, MO Milwaukee, WI Minneapolis-St. Paul, MN St. Louis, MO - East St. Louis, IL
South	West
Atlanta GA Baltimore, MD Dallas, TX Houston, TX New Orleans, LA Norfolk, VA Tampa, FL	Los Angeles, CA Portland, OR San Francisco-Oakland, CA San Jose, CA

were to meet the following criteria:

(1) One community was to be affected by odors commonly considered to be unpleasant. Another community was to be affected by odors usually considered pleasant in moderate strength.

(2) The odors in each community were to be caused by a single plant or a small complex of similar plants well removed from other sources.

(3) The odors were to have been a recent occurrence in both communities, preferably occurring for the first time within the past two years.

(4) Each of the communities was to contain at least 500 occupied homes.

The first criterion was chosen to permit a comparison of the social and economic effects of odors having vastly different qualities, but (ideally) similar intensities. The second was to benefit the use of sensory techniques for evaluating odor intensities throughout the communities. The third was to provide a basis for a study of changes in property values over time, which may have been attributable to odors. The final criterion was simply to ensure that the number of households sampled for the planned public attitude surveys in each community would not approach a census of all households in those communities.

Selection of Los Angeles, CA

Copley International Corporation contacted air pollution control agencies in 21 of the potential odor problem areas listed in Table 1 to locate the needed communities. (Ten of the areas were avoided because of possible severe and prolonged winter weather conditions which might have adversely affected the field work performed during the current project.) Considerable difficulty was encountered in meeting the third criterion. Either no new industrial plants or processes had begun operations within the past two years or the emissions of such plants and processes were tightly controlled in accordance with recently enacted state and local environmental protection laws.

Visits were made to several metropolitan areas having communities which were thought to meet the stated criteria. Recent publicity about unpleasant odors drew attention to the Los Angeles metropolitan area. A situation, seemingly ideal for the present study, was found in the Los Angeles community of Hawthorne. According to statements in the news media, Hawthorne had been often exposed to strong hydrogen sulfide, sulfur dioxide, and mercaptan odors caused by a major oil refinery and chemical plant complex. Complaints about these unpleasant odors, which had been verified by local authorities, accelerated from annual rates of less than 20 at the end of 1967 to almost 300 by mid-1970. Although a community affected by pleasant odors was not immediately evident, a search for such a situation was directed toward possible sources.

A list of 440 plants involved in the manufacture of foods, beverages, paints, perfumes, plastics, or soaps in the Los Angeles metropolitan area was prepared from information compiled during the national survey. These sources were quickly screened on the basis of size of operation (using number of employees as a guide), isolation from other sources, and proximity to residential areas. The remaining plants — about 5 percent of the initial list — were inspected to determine their suitability for study. Odors caused by two large bakeries were detected in residential areas of Glendale and Beverly Hills, and odors from a paint and varnish factory were found in a populated area of Torrance. In addition, unpleasant odors from a second major oil refinery were detected when traveling in a Torrance residential area immediately to the east of that affected by the paint and varnish factory. A difficulty was found in that none of these sources was newly established. However, because of the seemingly ideal situation in Hawthorne and the broad range of odor producing industries, the tendency of the natural environment to support odor problems, and the diversity of the population in the Los Angeles metropolitan area, the third criterion was relaxed.

DESCRIPTION OF THE SOURCES

The oil refinery and chemical plant complex causing odors in Hawthorne is located in the neighboring community of El Segundo (Figures 1 and 3). The oldest section of the refinery was built about 60 years ago. The refinery now employs 1,300 individuals and has a capacity to process 220,000 barrels per day of crude oil into a variety of intermediate and end products. Most of the refinery operations are concentrated in the northern part of the compound. Butadiene, naptha re-run, cumene, and asphalt plants are situated in the northern part. Thermal cracking, sulfur dioxide treating, liquid petroleum gas production, and alkylation plants are situated just south of these. Aromatics and paraxylene plants are located in the eastern part of the refinery.

The chemical plant, operated by a different firm, is located just east of the refinery property limits. The plant recovers certain materials, including sulfur, from by-products of the refinery operations. Although the chemical plant has been in operation since 1920, its sulfur production rose sharply after 1967 as a result of new and modernized refinery operations. The plant employs 130 individuals.

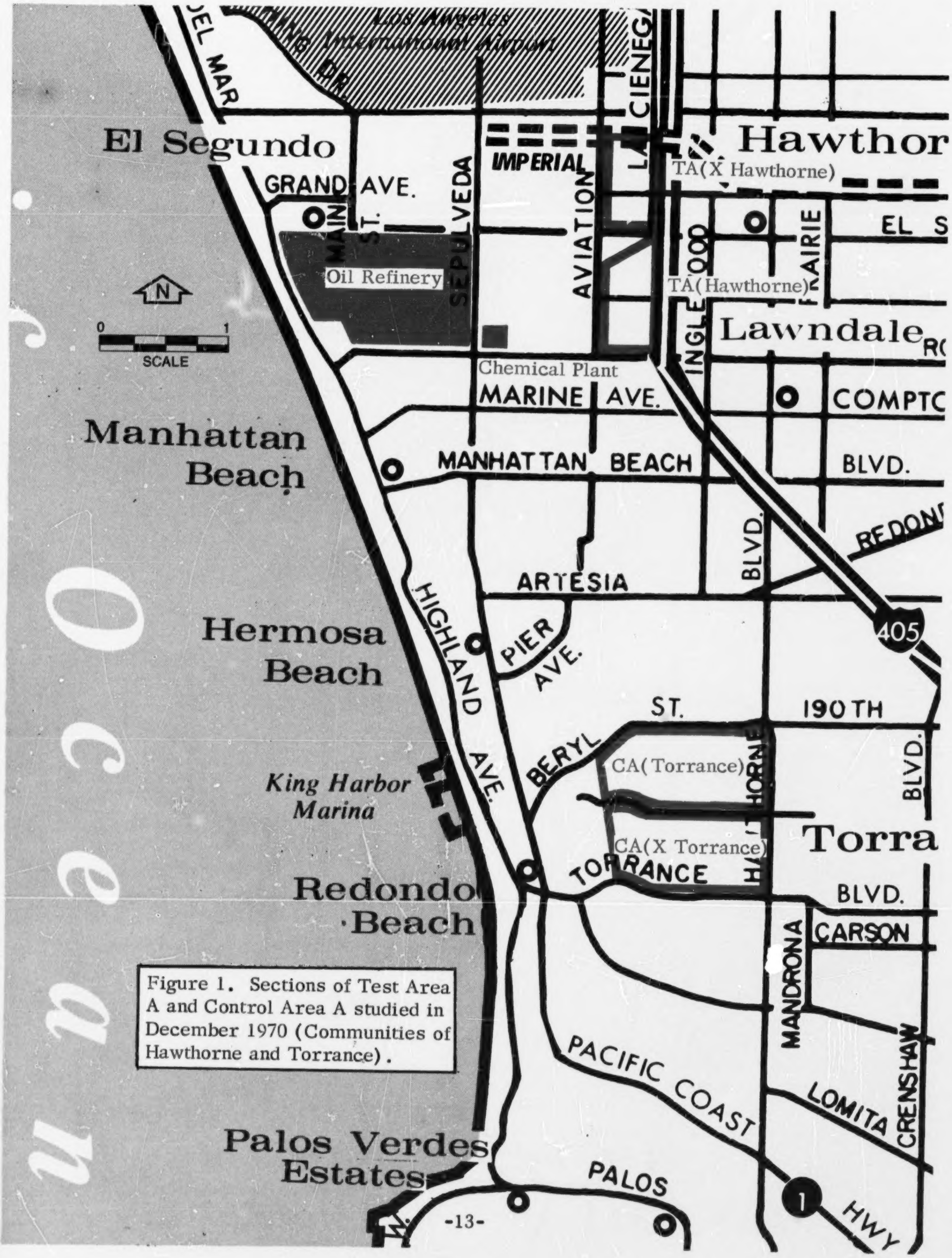
The bakery located in Glendale (Figure 2a) began operations in 1927. At present, it employs 225 individuals. The Beverly Hills bakery (Figure 4a) was established approximately 40 years ago. It employs about 350 individuals. Bread is the principal product of both plants.

The paint and varnish factory (Figure 2b) is the newest establishment, having been built in 1956. Eight hundred employees report to this facility, but only a fraction of these are involved with the manufacturing processes. The second oil refinery, like the paint and varnish factory, is located in Torrance (Figures 2b and 4b). The oldest section of the refinery was built in 1928. The refinery was modernized in 1966 and now employs 700 individuals and has a capacity to process 125,000 barrels per day of crude oil.

SELECTION OF TEST AND CONTROL AREAS

Delineation of Test Areas

The odors caused by the two bakeries, the paint and varnish factory, and the second oil refinery did not seem to be as intense in nearby residential


Los Angeles International Airport
DEL MAR
DR
El Segundo
IMPERIAL
LA CIENEGA
Hawthor
TA(X Hawthorne)
GRAND AVE.
MAIN ST.
SEPULVEDA
AVIATION
INGLEWOOD
PRAIRIE
EL S
Oil Refinery
TA(Hawthorne)
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Lawndale
Chemical Plant
MARINE AVE.
COMPTO
Manhattan Beach
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BLVD.
REDOND
ARTESIA
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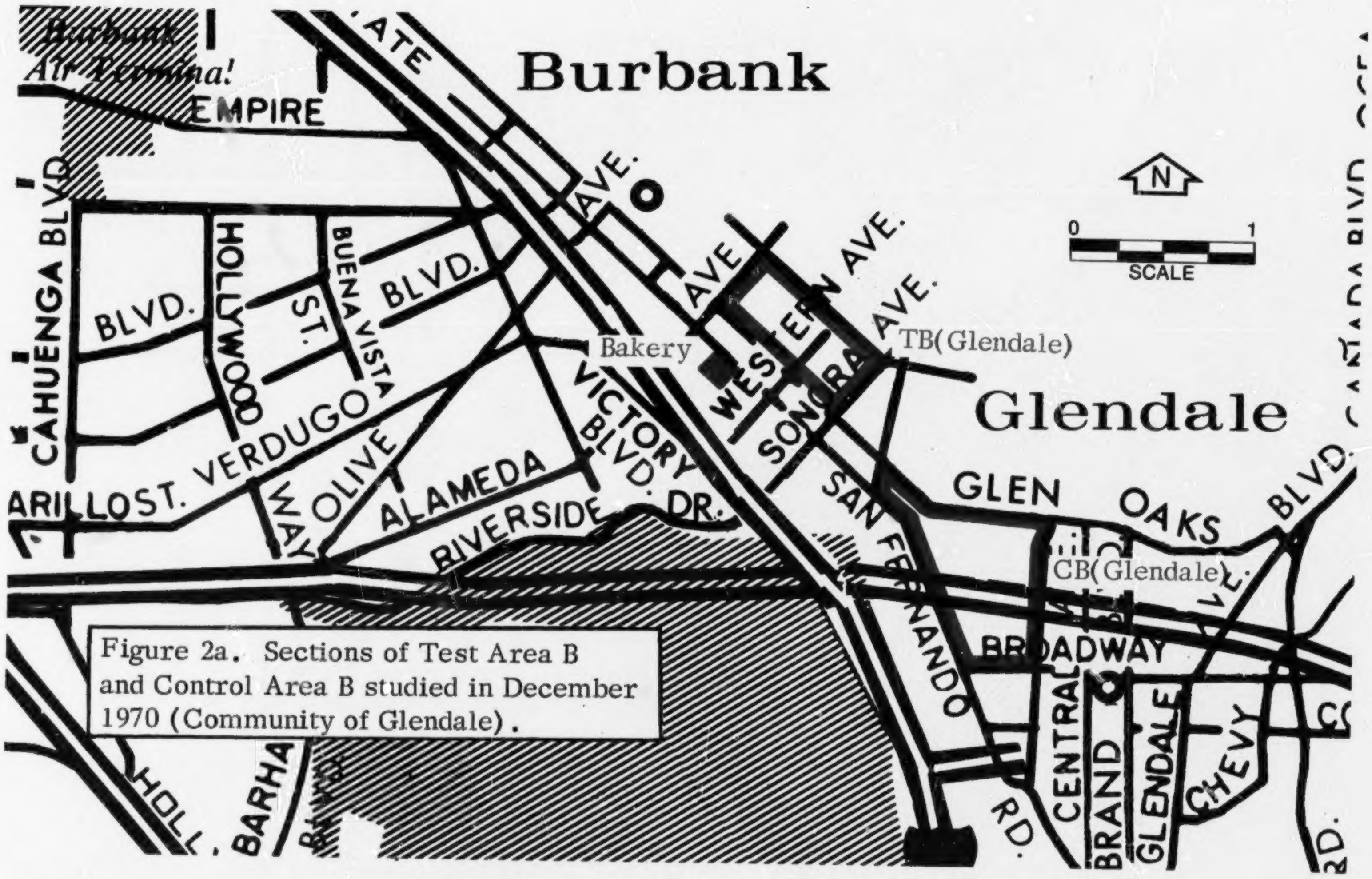
Ocean
Hermosa Beach
HIGHLAND AVE.
PIER AVE.
ST.
190TH
BERYL
CA(Torrance)
HAWTHORNE
BLVD.
King Harbor Marina
CA(X Torrance)
Torra
TORRANCE BLVD.
Redondo Beach
CARSON
MANDRONA
CRENSHAW
PACIFIC COAST HWY
LOMITA
1
Palos Verdes Estates
PALOS

Figure 1. Sections of Test Area A and Control Area A studied in December 1970 (Communities of Hawthorne and Torrance).


Burbank Air Terminal
Burbank
EMPIRE
CAHUENGA BLVD
HOLLYWOOD
BLVD.
BUENA VISTA
ST.
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AVE
WESTERN AVE.
SONORA AVE.
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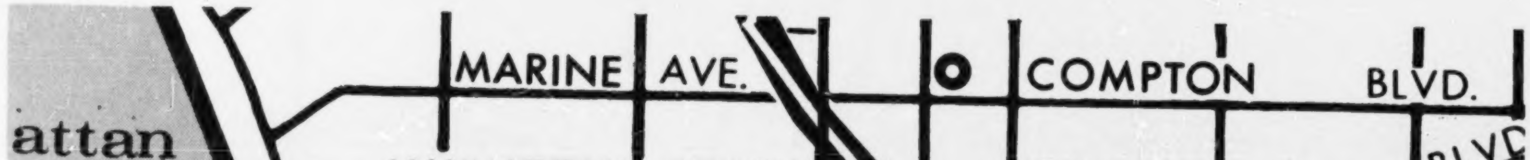
Bakery
TB(Glendale)
Glendale
VICTORY BLVD.
LOST. VERDUGO
OLIVE
WAY
ALAMEDA
RIVERSIDE
DR.
SAN FERNANDO RD.
GLEN OAKS BLVD.
CB(Glendale)
BROADWAY
CENTRAL
BRAND
GLENDALE
CHEVY
BARHAM
HOLL

Figure 2a. Sections of Test Area B and Control Area B studied in December 1970 (Community of Glendale).


MARINE AVE.
COMPTON BLVD.
Manhattan Beach
MANHATTAN BEACH BLVD.
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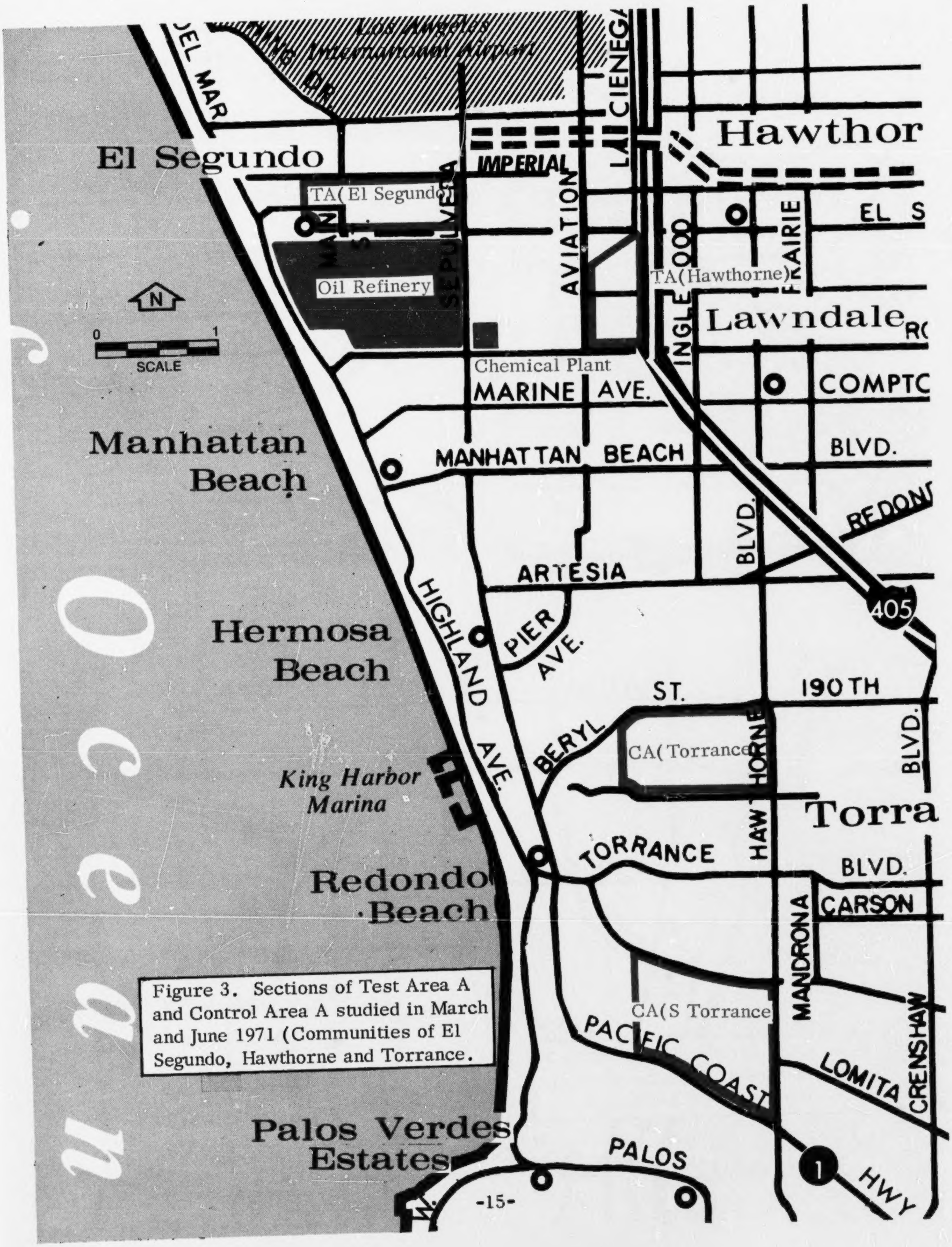
SCALE
REDONDO BEACH BLVD
GARDENA
Gardena
CB(Torrance)
BLVD.
ARTESIA
BLVD.
TB(X Torrance)
405
Hermosa Beach
HIGHLAND
PIER AVE.
AVE.
TB(Torrance)
ST.
190TH
BERYL
Paint and Varnish Factory
Oil Refinery
HAWTHORNE
Torrance
NORMANDIE
TORRANCE
BLVD.
AVE.
Redondo Beach
CARSON

Figure 2b. Sections of Test Area B and Control Area B studied in December 1970 (Community of Torrance)


Los Angeles International Airport
DEL MAR
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Hawthor
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SEPULVEDA
AVIATION
Oil Refinery
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INGLEWOOD
PRAIRIE
TA(Hawthorne)
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Chemical Plant
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MANHATTAN BEACH
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Redondo Beach
CARSON
MANDRONA
CA(S Torrance
PACIFIC COAST
LOMITA
CRENSHAW
Palos Verdes Estates
PALOS
1
HWY

Figure 3. Sections of Test Area A and Control Area A studied in March and June 1971 (Communities of El Segundo, Hawthorne and Torrance.

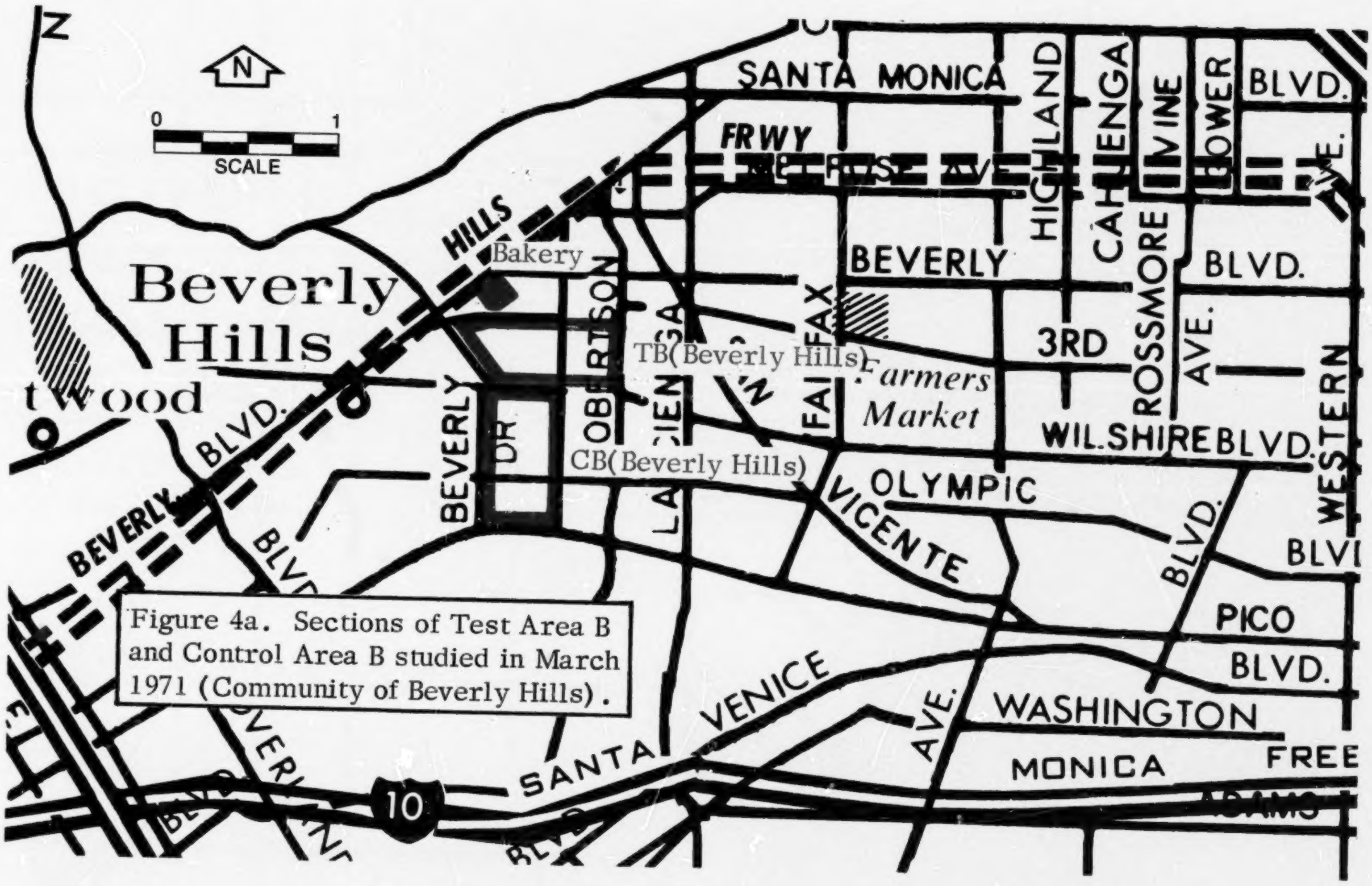

Figure 4a. Sections of Test Area B and Control Area B studied in March 1971 (Community of Beverly Hills).

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MELROSE AVE.
HILLS
Bakery
BEVERLY
BLVD.
HIGHLAND
CAHUENGA
VINE
GOWER
ROSSMORE
AVE.
3RD
TB(Beverly Hills)
Farmers
Market
WILSHIRE BLVD.
WESTERN
CB(Beverly Hills)
OLYMPIC
VICENTE
BEVERLY
DR
ROBERTSON
LA CIENEGA
FAIRFAX
PICO
BLVD.
WASHINGTON
VENICE
SANTA MONICA
FREE
ADAMS
10

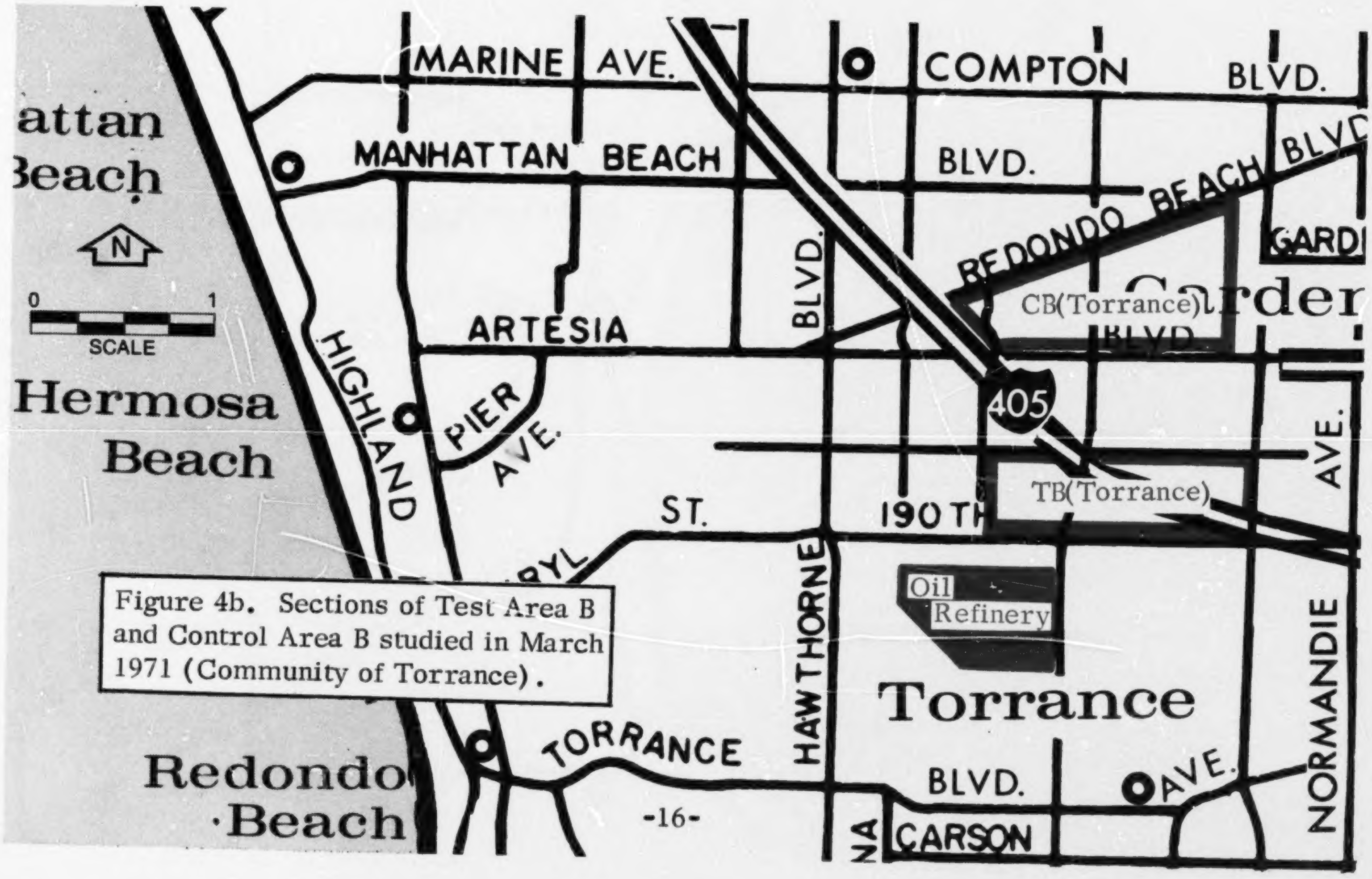

Figure 4b. Sections of Test Area B and Control Area B studied in March 1971 (Community of Torrance).

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Beach
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Hermosa
Beach
Redondo
Beach
MARINE AVE.
COMPTON BLVD.
MANHATTAN BEACH BLVD.
REDONDO BEACH BLVD.
GARD
Garden
CB(Torrance)
BLVD.
ARTESIA
HIGHLAND
PIER AVE.
405
TB(Torrance)
ST.
190TH
Oil
Refinery
Torrance
HAWTHORNE
BLVD.
TORRANCE
BLVD.
CARSON
AVE.
NORMANDIE
AVE.

areas as those detected in Hawthorne. Certainly, the adverse publicity about bad smells seemed focused on Hawthorne. Thus, it was decided to concentrate half of the field work on the situation in Hawthorne and to divide the remaining half among the possible odor problems in the other communities. For convenient reference, as is indicated in Table 2, the residential areas affected by odors in Hawthorne were designated Test Area A. The populated areas affected by odors in the other communities were designated Test Area B. Each of the residential areas ("sections" of Test Area A and Test Area B) approximated census tracts. The location of these areas is shown in Figures 1 through 4.

Location of Control Areas

The results of the public attitude surveys scheduled for the test areas were to be compared to the results of identical surveys scheduled for communities having similar socioeconomic characteristics as the test areas, but having no odors. Matching control areas were located, as indicated in Table 2 and Figures 1 through 4. (The reader may wish to refer to Appendix A to view the locations of all test and control areas on a single map.) The socioeconomic characteristics of the matched communities are given in Table 3 in terms of 1960 data prepared by the Bureau of the Census and in Table 4 in terms of 1970 data obtained from the same Bureau and the results of the public attitude surveys conducted in the areas by Copley International Corporation in December 1970, March 1971, and June 1971. With the exception of TA(X Hawthorne)/ CA(X Torrance), the socioeconomic characteristics of the control areas were generally within 10 percent of those of the test areas. Additional characteristics considered in the selection of the control areas are mentioned in Chapter IV.

One other criterion was established for the selection of CA(Torrance). This control area was purposely chosen upwind of the second oil refinery (compare Figures 1 and 2b). The intent of this strategy was to eliminate as many factors as possible other than odors that might have contributed to property value differentials between CA(Torrance) and TA(Hawthorne). The results of a comparison of property values in these areas is the subject of Chapter VI.

Changes in Test and Control Areas

After the December public attitude surveys, it was decided to substitute TA(El Segundo) for TA(X Hawthorne) because odors were more often detected beyond the northern property limits of the oil refinery than in TA(X Hawthorne). In addition, CA(South Torrance) was substituted for CA(X Torrance) to more closely match the socioeconomic characteristics of TA(El Segundo).

Since the results of the December surveys indicated no reaction to odors caused by either the paint and varnish factory or the bakery, TB(X Torrance), TB(Glendale), and CB(Glendale) were dropped from further consideration. One more attempt was made to measure reaction to pleasant odors. TB(Beverly Hills)

Table 2. List of test areas, control areas, and odor sources studied in the Los Angeles metropolitan area by month in which studies were conducted.

Month	Area	Odor Source
December 1970	Test Area A (two sections):	
	1. TA(Hawthorne)	oil refinery and chemical plant
	2. TA(X Hawthorne)	oil refinery and chemical plant
	Control Area A (two sections):	
	1. CA(Torrance)	
	2. CA(X Torrance)	
	Test Area B (three sections):	
	1. TB(Torrance)	second oil refinery
	2. TB(X Torrance)	paint and varnish factory
	3. TB(Glendale)	bakery
	Control Area B (two sections):	
	1. CB(Torrance)	
	2. CB(Glendale)	
March 1971	Test Area A (two sections):	
	1. TA(Hawthorne)	oil refinery and chemical plant
	2. TA(El Segundo)	oil refinery and chemical plant
	Control Area A (two sections):	
	1. CA(Torrance)	
	2. CA(South Torrance)	
	Test Area B (two sections):	
	1. TB(Torrance)	second oil refinery
	2. TB(Beverly Hills)	bakery
	Control Area B (two sections):	
	1. CB(Torrance)	
	2. CB(Beverly Hills)	
June 1971	Test Area A (two sections):	
	1. TA(Hawthorne)	oil refinery and chemical plant
	2. TA(El Segundo)	oil refinery and chemical plant
	Control Area A (two sections):	
	1. CA(Torrance)	
	2. CA(South Torrance)	

"X" before name of community indicates area studied in December 1970 was replaced by alternate area in March 1971. TB(X Torrance) was eliminated from further consideration.

Table 3. Socioeconomic characteristics of all matched test and control areas studied in the Los Angeles metropolitan area (1960 data).

Area/Census Tract No.	Median Family Income	Median Education	Homes Built in the 1950's	Median Home Value
TA(Hawthorne)/6023	$8,456	12.6 yrs.	99.4%	$19,300
CA(Torrance)/6505	7,926	12.3	100.0	17,400
TA(X Hawthorne)/6022	7,832	12.2	30.6	14,700
CA(X Torrance)/6506	8,662	12.4	80.9	21,600
TA(El Segundo)/6200/6201	7,834*	12.3*	51.9*	18,450*
CA(South Torrance)/6512	7,998	12.5	82.4	16,800
TB(Torrance)/6502	7,867	12.3	94.1	16,200
CB(Torrance)/6500	8,079	12.3	85.6	17,700
TB(X Torrance)/6503	7,683	12.1	81.1	16,200
CB(Torrance)/6500	8,079	12.3	85.6	17,700
TB(Glendale)/3015	7,263	12.1	16.1	15,500
CB(Glendale)/3017	6,768	12.0	13.1	15,500
TB(Beverly Hills)/7008	8,191	12.5	15.0	31,700
CB(Beverly Hills)/7009	8,656	12.6	20.8	28,700

* Characteristics averaged together.

Source: U. S. Department of Commerce, Bureau of the Census.

Table 4. Socioeconomic characteristics of all matched test and control areas studied in the Los Angeles metropolitan area (1970 data).

Area/Census Tract No.	Median Family Income(1)	Median Education of Respondents(1)	Median Age of Respondents(1)	Median Home Value(2)
TA(Hawthorne)/6023	$13,900	13.0 yrs.	42.1 yrs.	$29,580
CA(Torrance)/6505	12,800	12.9	40.1	27,850
TA(X Hawthorne)/6022	11,500	12.7	45.3	23,705
CA(X Torrance)/6506	13,400	14.7	38.5	33,990
TA(El Segundo)/6200/6201	12,100	12.8	47.2	30,135*
CA(South Torrance)/6512	13,800	14.8	40.5	32,905
TB(Torrance)/6502	12,400	12.7	42.9	25,330
CB(Torrance)/6500	11,800	12.9	41.2	27,350
TB(X Torrance)/6503	12,800	12.9	37.4	24,325
CB(Torrance)/6500	11,800	12.9	41.2	27,350
TB(Glendale)/3015	8,800	12.7	48.7	23,860
CB(Glendale)/3017	7,900	12.7	53.0	23,765
TB(Beverly Hills)/7008	14,545	15.0	52.5	50,000+
CB(Beverly Hills)/7009	15,000+	16.0	53.6	50,000+

* Characteristics averaged together.

Source: (1) Copley International Corporation (1970 and 1971 data taken from the results of the public attitude surveys).
(2) U. S. Department of Commerce, Bureau of the Census (preliminary data).

and CB(Beverly Hills) were surveyed in March. Although the residents of the Beverly Hills test area enjoyed higher median family incomes than the residents of the Glendale test area, they were not more vocal about bakery odors. All of the sections of Test Area B and Control Area B were eliminated from further consideration after the March surveys.

NATURAL CONDITIONS ENCOUNTERED

Topographical Features

The surface of almost all of the test and control areas studied was quite flat. The single exception was TA(El Segundo) which had several hills ranging from about 100 feet to 200 feet above sea level. For reference in reviewing the results of the technical field studies in Chapter V, topographical maps of TA(El Segundo) and TA(Hawthorne) are included in Appendix A.

Weather Conditions

Except for rains encountered during the first two days of the December surveys, the main adversity with the weather was occasional moderate to strong winds which tended to increase the transiency of any odors being detected.

Estimates of both seasonal and hourly variations in winds in Test Area A are given in Figure 5 for the first days on which surveys were conducted in each of the three months. Note that the percentage of westerly winds increased as summer approached. More detailed local climatological data for the months in which the surveys were conducted are also included in Appendix A.

REFERENCES

U. S. Bureau of the Census. U. S. Censuses of Population and Housing: 1960. Census Tracts. Final Report PHC(1)-82. Washington, D.C.: U. S. Government Printing Office, 1962.

National Oceanic and Atmospheric Administration. Local Climatological Data: Los Angeles International Airport. Washington, D.C.: U. S. Government Printing Office, December 1970, March 1971, and June 1971.

Figure 5a. Hourly wind direction and velocity recorded at Los Angeles International Airport, December 1, 1971.

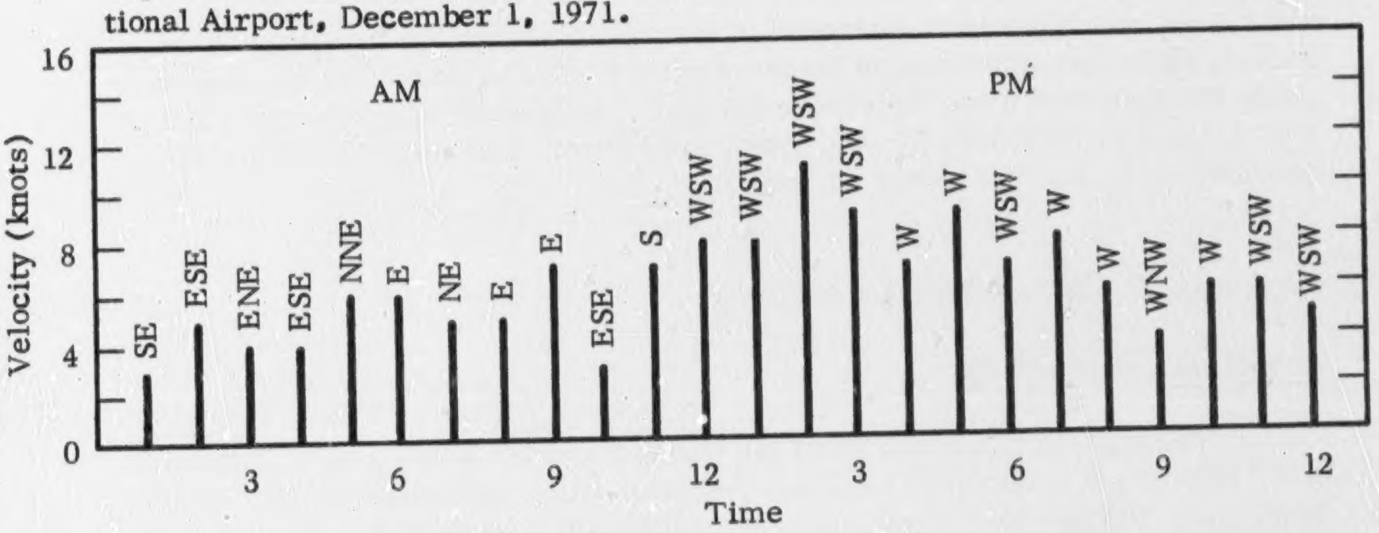


Figure 5b. Hourly wind direction and velocity recorded at Los Angeles International Airport, March 16, 1971.

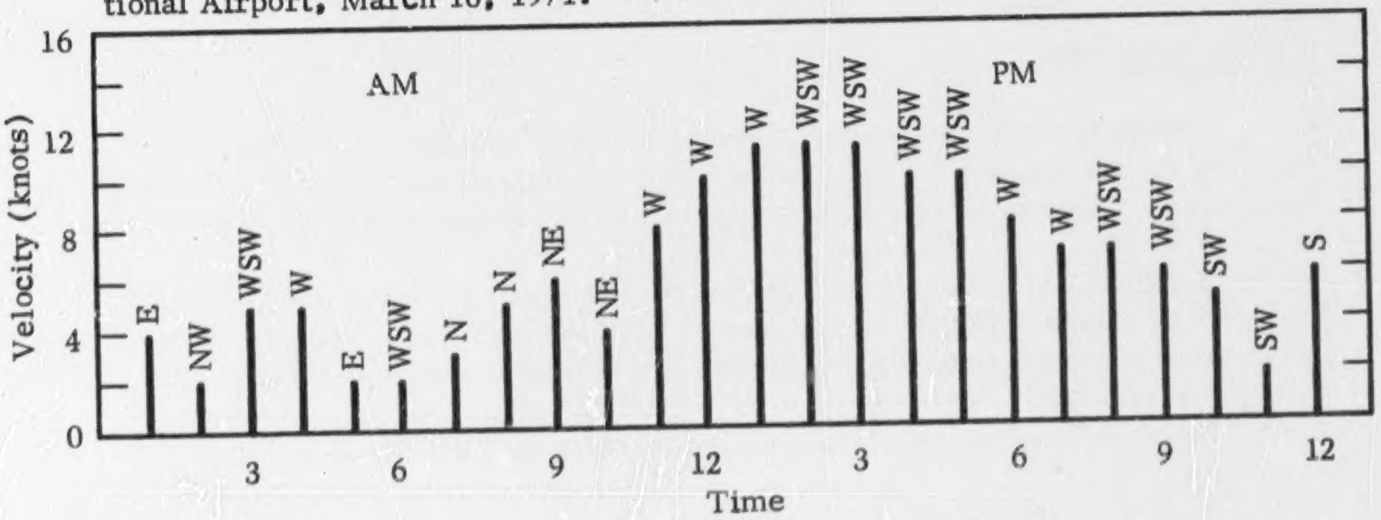
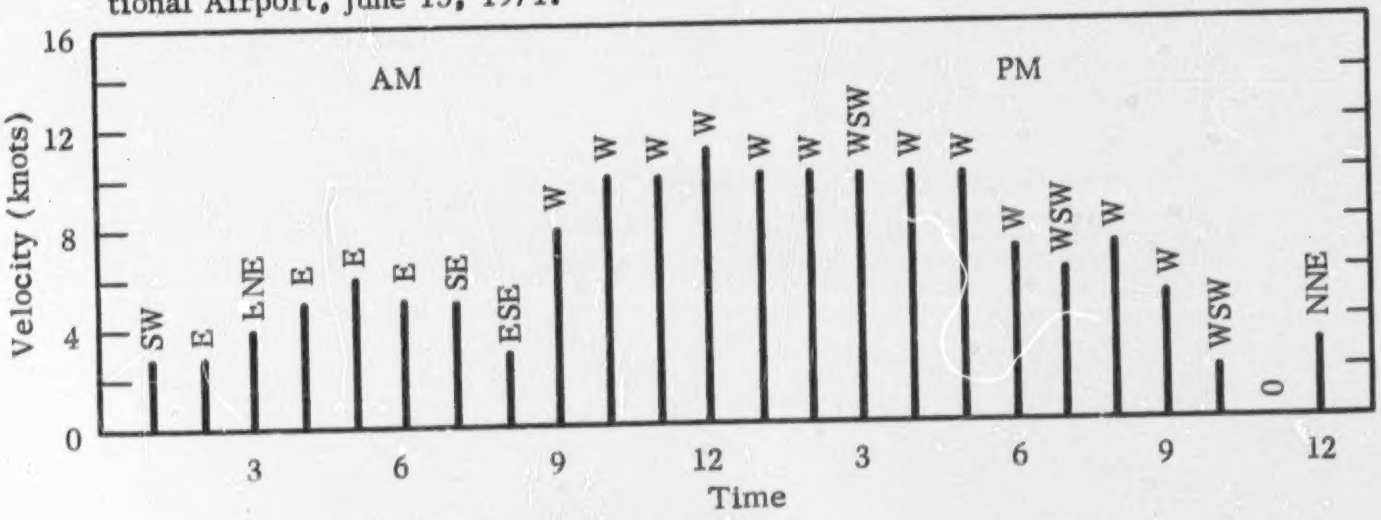


Figure 5c. Hourly wind direction and velocity recorded at Los Angeles International Airport, June 15, 1971.



Source: U. S. Department of Commerce, National Oceanic and Atmospheric Administration and CB(Beverly Hills) were surveyed in March. Although the residents of the Beverly Hills test area enjoyed higher median family incomes than the residents of the Glendale test area, they were not more vocal about bakery odors. All of the sections of Test Area B and Control Area B were eliminated from further consideration after the March surveys.

NATURAL CONDITIONS ENCOUNTERED

Topographical Features

The surface of almost all of the test and control areas studied was quite flat. The single exception was TA(El Segundo) which had several hills ranging from about 100 feet to 200 feet above sea level. For reference in reviewing the results of the technical field studies in Chapter V, topographical maps of TA(El Segundo) and TA(Hawthorne) are included in Appendix A.

Weather Conditions

Except for rains encountered during the first two days of the December surveys, the main adversity with the weather was occasional moderate to strong winds which tended to increase the transiency of any odors being detected.

Estimates of both seasonal and hourly variations in winds in Test Area A are given in Figure 5 for the first days on which surveys were conducted in each of the three months. Note that the percentage of westerly winds increased as summer approached. More detailed local climatological data for the months in which the surveys were conducted are also included in Appendix A.

REFERENCES

U. S. Bureau of the Census. U. S. Censuses of Population and Housing: 1960. Census Tracts. Final Report PHC(1)-82. Washington, D.C.: U. S. Government Printing Office, 1962.

National Oceanic and Atmospheric Administration. Local Climatological Data: Los Angeles International Airport. Washington, D.C.: U. S. Government Printing Office, December 1970, March 1971, and June 1971.

CHAPTER III

CONCEPTUAL PROBLEMS WITH PUBLIC ATTITUDE SURVEYS

The purpose of this chapter is to discuss the conceptual problems encountered in gathering and interpreting data by means of public attitude surveys. The first section of the chapter serves as a primer on minimizing distortion to the results of attitude research. In connection with this, specific techniques employed to minimize the sources of bias in the surveys undertaken in the Los Angeles metropolitan area during the current project are discussed. The final section describes a method advanced by signal detection theory for estimating true attitudes from responses about odors under investigation.

THE PROBLEM OF BIAS

Potential Sources of Bias

Bias can be injected into a public attitude survey from one or more of the following sources:

- Population definition
- Test and control group selection
- Respondent selection
- Survey response generation
- Questionnaire formulation
- Interview completion

Sequentially, the first potential source for bias in a survey lies in the area of population definition. The population to be studied must be defined in such a manner that individual members can be identified. The definition can be geographical, relating to where the population can be found, and demographical, relating to the vital statistics of that population. Any number of distinguishing traits can be utilized in properly defining a population. The potential for bias occurs when information about a certain population is desired, yet the researcher defines a somewhat different population. Data generated can be relevant only to the population tested, yet conclusions are often projected to the population about which information was desired.

Of equal importance to the proper definition of a population is the proper division of that population into test and control groups. The only difference between the two groups should be the presence of the variable to be tested in the test group (noticeable odors, in this study) and the absence of that variable in the control group. An error in the selection of the control group and, hence, the statistics generated from that group, would affect the measurement of difference between the two groups and introduce a bias in the findings.

Statistical theory is dependent upon a representative sample, where every member of the population has an equal chance of being included in the sample. Such a requirement is satisfied by random selection of the sample, which, if done properly, creates a mirror-image microcosm of the larger population. If randomness in the sample selection is not maintained, the researcher incurs a risk that the statistics generated will not be representative of the population ostensibly under study. Non-randomness normally occurs when an unsystematic approach to selecting individual members of the population is utilized. For example, when sample selection is based on factors such as the pleasing personality of a potential respondent, the easy availability of the respondent, or the motivation of the respondent to participate, a bias resulting from selection of an unrepresentative sample is likely to occur.

The bias of an unrepresentative sample can be introduced into a study even when a sample has been randomly selected. This results when a significant percentage of the randomly selected sample is unreachable for interviewing or refuses to be questioned. In general, as the response rate to a survey decreases, the potential for this type of bias increases. The reason for this is that non-respondents have been shown repeatedly to be different from respondents to a survey. Whether or not these differences are significant in terms of the specific variables under study depends upon the individual project. The only way of insuring against the possibility of bias in this case, however, is to increase the response rate to as high a level as possible.

The questionnaire, itself, is a tremendous potential source of bias in a survey. The appropriateness of the data collected in a survey is a direct function of the precision of the questions asked. Questions which are unclear in meaning will yield answers which are also unclear in meaning. Misinterpreted questions introduce bias when their answers are analyzed in terms of the intended meaning of the questions. Improperly worded questions have the capacity of confusing, embarrassing, antagonizing, or leading the respondent, all of which introduce bias into the data. Questions which unconsciously reflect the attitude of the question designer can introduce significant bias into the responses. The sequence in which questions are asked can have a profound effect upon the responses obtained. The questionnaire should be structured so that earlier questions do not exert an unforeseen influence on latter questions.

Another source of bias in the questionnaire occurs when the respondent is asked for information which is not readily at his disposal. Although respondents often will supply answers to such questions, these replies may represent totally unfounded guesses.

Interviewers can introduce bias into a survey in several ways. The most dramatic example of this is deliberate cheating on the part of the interviewer. All or part of the questionnaire can be filled out by the interviewer without even contacting the respondent. To the interviewer, it is quicker, cheaper, and easier. To the researcher, it means invalid data. Interviewers may consciously or unconsciously create bias in a survey by leading the respondent, making pertinent side comments, changing the wording of questions, failing to ask all questions, using certain inflections when asking questions, improperly recording a response, or failing to probe sufficiently to uncover the respondent's true feelings about a question.

In the current project, specific effort was undertaken to avoid or significantly decrease the chance for bias in each of the foregoing six areas.

Techniques Employed to Minimize Bias

The populations to be studied in the Los Angeles metropolitan area were representative of middle-class, adult residents. They were specifically defined in terms of median family income, median education, median housing value, and type of housing units. It was intended that they would be exposed to specific odors of industrial origin. Hence, they were chosen from areas in proximity to odorant emitting industrial plants. Their neighborhoods were designated as "test" areas.

A myriad of geographical and demographical data was assembled to represent each test area, after which "control" areas were sought which closely approximated these same identifying traits. The specification of identical characteristics for test and control groups insured the validity of using such groups in identifying odor-caused variances. The procedures utilized in test and control area selection are discussed in Chapter II.

Once test and control groups were selected, a complete schedule of individuals in these groups, who had listed telephones, was obtained through use of a street address (reverse order) telephone directory. A random selection of samples was conducted by professional personnel. Interviewers were not permitted to take part in the selection process, but were given names, addresses, and telephone numbers of the individuals to be contacted.

Possible bias stemming from non-response was almost entirely eliminated in the project. This was due to an unusually stringent demand that interviewers attempt to contact the original respondent six times before substituting alternates. Interviewers were further instructed to make callbacks at varying times of the day to maximize the chances of finding the respondent at home. Non-response stemming from refusals to cooperate was controlled through the design of a brief questionnaire form, the avoidance of antagonizing phraseology, and use of a highly trained and experienced interviewing staff.

The many sources of bias that can be associated with the questionnaire were rigorously controlled through the design. The data to be collected were generally specified by the Environmental Protection Agency. To meet the requirements, questions were taken from the national survey of the odor problem, recent studies completed in Sweden and the United States, and the experience of the Copley International Corporation consumer research staff. Several versions of a questionnaire were constructed, pretested, reviewed, and refined before a final form was adopted.

Interviewer bias was reduced by employment of only experienced interviewers, detailed written and verbal briefings of interviewers, one-hundred percent editing of all completed questionnaires for internal consistency, and verification of respondents' answers on over 10 percent of the completed questionnaires.

THE PROBLEM OF ESTIMATING TRUE ATTITUDES

The most difficult problem with public attitude surveys is encountered with the interpretation of results. It is the problem of estimating true attitudes from the typically varied responses of the population under investigation. To attain a high level of confidence in the results, the whole population or at least many individuals in the population must be interviewed. By doing so, the results would indicate what the population says about the variable under study, but it remains uncertain whether they would reflect what the population feels about that variable.

It could be argued that an individual's responses to carefully designed survey questions reflect his attitude. Then, varied responses in the results of the survey would simply indicate varied feelings. Yet, despite the amount of care given to question design or other aspects of a public attitude survey, an individual's responses may be biased by a myriad of variables other than the one of concern. For example, an individual may complain about odors in his neighborhood because he holds some unrelated resentment against the possible source, because he believes it is popular to complain about such things, because he has a strong propensity to neurosis, or because he is bothered by odors. From this, it can be seen that varied responses in the survey results could obscure true feelings. Although the essence of this problem lies beyond the researcher's control, an adjustment can be made to minimize its weight.

The use of results of an identical survey of a control group is the key to estimating true attitudes in the population under investigation. The basis for this and the related adjustment are most easily discussed in terms of a theory developed for radar communications, viz., signal detection theory. Two descriptors — noise and signal — provide part of the basic nomenclature of this theory. As such, they are defined and employed extensively below.

Responses based on the interaction of variables other than the one of concern in the research are called "noise." In the present study, "noise" refers to responses by individuals that they noticed or, most importantly, were bothered by odors in their neighborhoods when the location of sources or meteorological conditions were such that odors (other than low intensity background odors) could not have been detected. "Noise" in this sense may exist to some level in all test and control areas. Conversely, "signal" refers to responses by individuals that they noticed or were bothered by odors when odors were present. By definition, "signal" can exist only in statistics generated within test areas.

The application of signal detection theory to the current project is graphically portrayed in Figure 6. The left-hand probability function, C, represents the probability of obtaining from control groups a percentage of responses, X, that odors were noticed or caused bother. In theory, if many control groups were properly selected and measured in terms of noticing or being bothered by odors, the percentages of affirmative responses would approach the normal distribution represented by C. The average level of "noise" that could be anticipated from such groups would be represented by the mean of that distribution, $\overline{X}_C$.

Similarly, T represents the theoretical distribution of the percentages of affirmative responses from many test groups. The mean of that distribution, $\overline{X}_T$, would represent the average level of "noise" plus "signal" that could be anticipated in test group data. An adjustment of the difference between the two means would give the average level of "signal" alone. The advocates of signal detection theory have adopted a formula for making such an adjustment. It can be applied to the results of surveys conducted in any set of test and control areas, but with less confidence than to the means of distributions such as those described above.

The formula is a Bayesian type of correction for chance success:

$$P'(S|s) = \frac{P(S|s) - P(S|n)}{100 - P(S|n)}$$

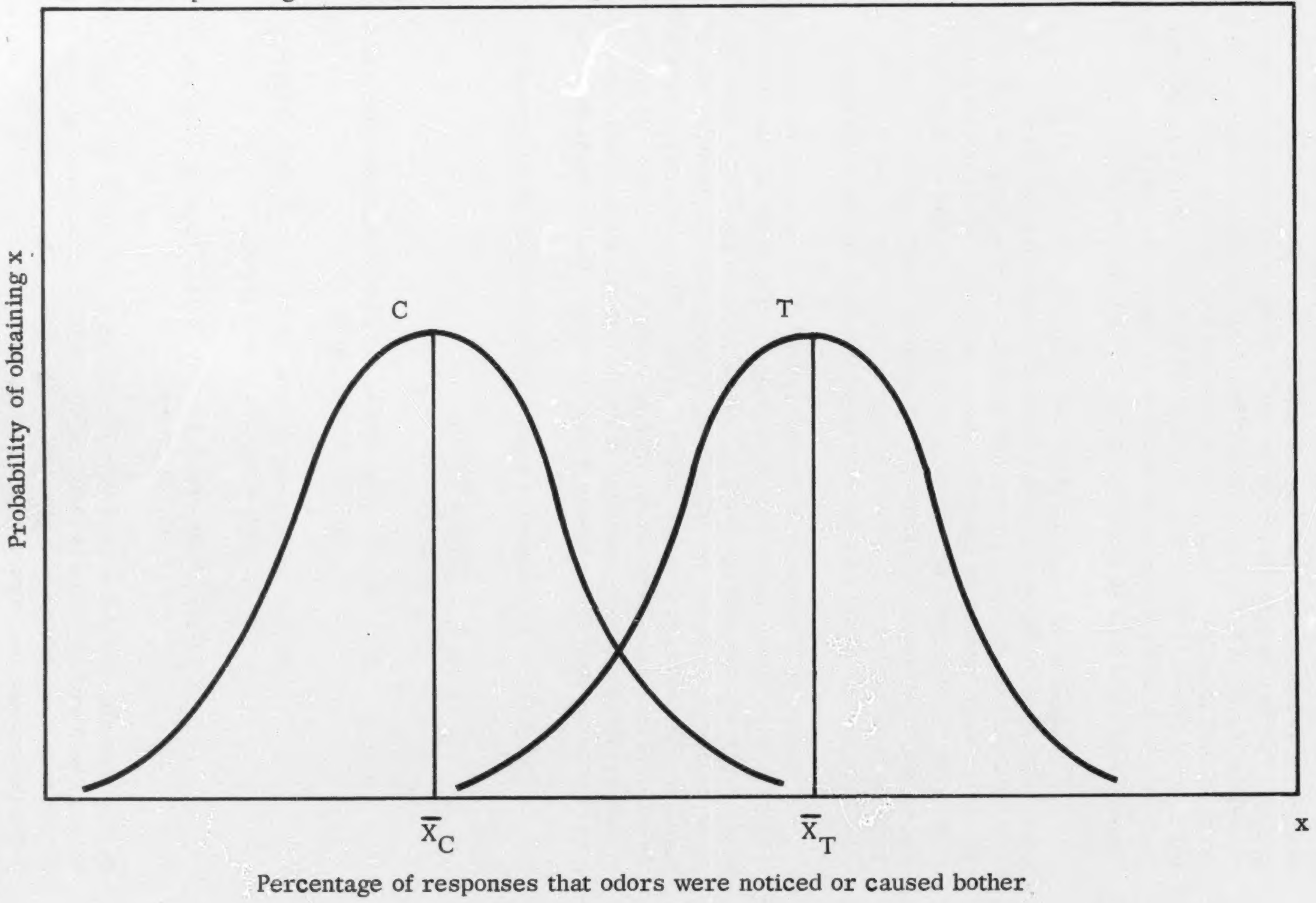
where: $P'(S|s)$ = the percentage of "signal" attributable to the variable under study

$P(S|s)$ = the total percentage of "noise" plus "signal" measured in the test group

$P(S|n)$ = the percentage of "noise" measured in the control group

By this formula, the percentage of control area respondents who say they noticed or were bothered by odors in their neighborhood is subtracted from the percentage of test area respondents who give the same reply. The resulting answer is related to the percentage in the control area who answer "correctly," i.e., who say they did not notice or were not bothered by odors in their neighborhood.

Figure 6. Probability functions of a variable (x), representing "noise" as measured in control groups and "noise" plus "signal" as measured in test groups.



The following chapter presents the results of the public attitude surveys conducted by Copley International Corporation in the Los Angeles metropolitan area. Adjustments to these results, using the formula adopted for signal detection theory, are discussed in Chapter VII.

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CHAPTER IV

PUBLIC ATTITUDE SURVEYS

Public attitude surveys were conducted at quarterly intervals — December 1970, March 1971, and June 1971 — during the present study of the Los Angeles metropolitan area. Telephone surveys rather than personal, face-to-face interviews were used. It was felt that telephone interviewing could adequately generate the data needed with greater efficiency and economy. The objectives of these surveys were:

(1) To gather data regarding the public's attitudes toward noticeable odors.

(2) To obtain an estimate of the existence and severity of community odor problems.

(3) To define the type and degree of social and economic effects odors have on residents and their property.

This chapter is divided into a description of the survey and a presentation of the results.

DEVELOPMENT OF THE SURVEY

Description of the Questionnaire

The survey questions chosen originated from five major sources:

(1) The national survey of the odor problem.

(2) A public opinion survey developed in connection with a pilot study in Eureka, California.

(3) Studies recently completed in Sweden.

(4) Insight gathered from six panel discussions held with male and female residents of Los Angeles.

(5) Suggestions of the Copley International Corporation consumer research staff.

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As indicated below, the questions were designed to cover topics to serve seven distinct purposes. They were structured in such a way as to minimize bias resulting from overemphasis of a particular topic. A copy of the questionnaire used in the public attitude surveys is included in Appendix B.

The first questions were introductory in nature to set the context of the survey in the minds of the respondents. They dealt with the residents' satisfaction with their neighborhood and perception of community problems. These questions also provided an opportunity for both unsolicited and solicited opinions regarding the presence and effects of odors in the neighborhood.

Question 6 was designed to mask the objectives of the survey. This multipart question concerned the existence of noise in the neighborhood.

Questions 5 and 7 were designed to determine whether residents felt that an odor problem existed in their neighborhood. Multi-part question 7 also covered the extent to which residents were bothered by odors, the source of the odors, and the severity of the problem.

The next group of questions, numbers 8 through 17, were included to assess possible social and economic effects of odors. These included the effect of odors on the activities and health of residents and the impact on home values and salability of their homes. Questions 8, 16, and 17 were designed to determine the strengths of respondents' attitudes as measured by willingness to take positive action to abate odor emissions.

The final set of questions, numbers 18 through 24, covered demographic data. These questions were designed to determine whether the test and control areas had been properly matched.

Questionnaire Pretest

Nine questionnaires were administered to residents of Los Angeles communities under consideration as possible test and control areas. The purpose of the pretest, conducted in October 1970, was to determine whether any difficulties existed relating to the wording or structure of the questionnaire. Minor alterations to the wording of some questions resulted from this effort.

Survey Technique

During each of the three surveys, telephone interviews were conducted with a random sample of the population. Interviews were undertaken on consecutive days with no more than four or less than three days devoted to any one test or control area. If the first call to a person selected as a part of the sample did not result in a completed interview, up to five additional calls were required. After the sixth call, a person who had not been reached was replaced with another chosen when the sample was drawn. This callback procedure insured a high interview completion rate from the original sample and thus increased confidence that the sample was representative of the area under study.

At least 10 percent of all completed interviews were verified by contacting the respondents a second time. In addition, completed questionnaires were carefully edited for internal consistency before tabulation of survey results was begun.

Selection of Test and Control Areas

The Los Angeles metropolitan area was chosen as the location of the study. The primary reasons for its selection were:

(1) The diversity of the population in terms of a variety of demographics.

(2) The broad range of industries representing potential odor producing sources.

(3) Its location in a region of atmospheric vulnerability to serious odor problems.

(4) The availability of areas in the industrial sector known to be affected by odorants from single stationary sources.

Telephone discussions with representatives of the air pollution control agency serving the area confirmed the accuracy of these observations.

Test areas suspected of having odor problems related to specific odor producing plants were selected. Control areas matching these test areas were chosen on the basis of the following criteria:

(1) Near the test area but not affected by odors.

(2) Access to freeways similar to the test area.

(3) Median family income not different from the test area by more than 10 percent.

(4) Median value of owner occupied housing units not different from the test area by more than 10 percent.

(5) Median gross rent of renter occupied housing not different from the test area by more than 10 percent.

(6) Average age of housing units (based on year structures were built) not different from the test area by more than 15 percent.

(7) Average number of units per structure not different from the test area by more than 15 percent.

(8) Median number of rooms per dwelling unit not different from the test area by more than 10 percent.

As is shown in Chapter II, these criteria guided selection of control areas that approximated the test areas except for the presence of odors.

Conduction of the Surveys

Samples were drawn for the test and control areas. The questionnaires were then administered by professional interviewers in each of the quarterly surveys conducted. The total number of interviews completed in each test and control area is given in Table 5. The location of the test and control areas, as well as their designations, are described in Chapter II.

SURVEY FINDINGS

The results of each quarterly survey were tabulated for each test and control area. Where appropriate, tests of statistical significance were made to support inferences drawn from differences between matched area results. For the most part, the survey findings focus on the social and economic impact of odors. To present a different perspective, the findings are categorized by type of odor source investigated and by principal areas surveyed. Detailed responses to questions asked of respondents in the principal test and control areas may be obtained from the tables contained in Appendix C of this report.

Effects of Odors By Type of Odor Source Investigated

Before presenting the findings, it is recalled that three types of odor sources were investigated in connection with the present study:

(1) Two oil refineries and a chemical plant said to cause unpleasant odors.

(2) A paint and varnish factory said to cause neutral (neither pleasant nor unpleasant) odors.

(3) Two bakeries said to cause pleasant odors.

Table 5. Number of interviews completed in each test and control area by month in which public attitude surveys were conducted.

Month	Area	No. of Interviews Completed
December 1970	Test Area A (two sections):	
	1. TA(Hawthorne)	75
	2. TA(X Hawthorne)	75
	Control Area A (two sections):	
	1. CA(Torrance)	50
	2. CA(X Torrance)	101
	Test Area B (three sections):	
	1. TB(Torrance)	54
	2. TB(X Torrance)	51
	3. TB(Glendale)	51
	Control Area B (two sections):	
	1. CB(Torrance)	110
	2. CB(Glendale)	51
March 1971	Test Area A (two sections):	
	1. TA(Hawthorne)	75
	2. TA(El Segundo)	75
	Control Area A (two sections):	
	1. CA(Torrance)	50
	2. CA(South Torrance)	50
	Test Area B (two sections):	
	1. TB(Torrance)	75
	2. TB(Beverly Hills)	50
	Control Area B (two sections):	
	1. CB(Torrance)	75
	2. CB(Beverly Hills)	50
June 1971	Test Area A (two sections):	
	1. TA(Hawthorne)	75
	2. TA(El Segundo)	75
	Control Area A (two sections):	
	1. CA(Torrance)	75
	2. CA(South Torrance)	75

"X" before name of community indicates area studied in December 1970 was replaced by alternate area in March 1971. TB(X Torrance) was eliminated from further consideration.

Effects of Odors Caused By the Oil Refineries and Chemical Plant. When asked whether odors had been noticed in the neighborhood during the previous three months, a sizeable proportion of both test and control area residents replied affirmatively. About two-thirds of test area respondents compared to half of the control area respondents had noticed odors. In part, the control area responses may have been the result of background odors generally found in most parts of the Los Angeles metropolitan area (question 7A).

Only those respondents who had noticed odors were asked about when and how often they noticed the odors and how long the odors lasted. Responses from test and control area residents were very similar. Differences in the time of day odors were noticed meshed closely with meteorological data on wind patterns (cf. the Local Climatological Data included in Appendix A). Very few respondents noticed odors everyday and, while variations in responses among once a week, once a month, and occasionally were found, no discernible pattern emerged. With regard to the duration of odors, a majority of both test and control area residents indicated odors were present for more than one hour but less than a day (questions 7B, 7C, and 7D).

A very large proportion of residents who noticed odors were bothered by them in both the test and control areas. At least three-fourths were bothered by odors. In TB(Torrance), during December nearly 98 percent reported being bothered. A majority of those bothered reported they were bothered either very much or much, except in Control Area A in December (question 7E).

Generally, those bothered by odors indicated that this occurred very often or often (question 7F). An overwhelming proportion of respondents bothered by odors said the strength of the odor bothered them most. The number of times the odor was noticed and the length of time it lasted was mentioned as most bothersome by less than 20 percent of the respondents in both test and control areas (question 7G).

Most test area residents were able to identify the source of the odorous emission which was under investigation. As expected, control area residents were usually unable to do so. An exception was CB(Torrance). A significant percentage of all respondents were unable to indicate any origin for the odors they noticed (question 7H).

In evaluating the seriousness of the odor problem, of those respondents who noticed odors, only a very small group felt the situation was less serious than it was a year ago. Slightly more respondents felt that odors were not a serious problem. The majority felt that the odor problem was continuous and serious or was increasing. No pattern of responses was noted with regard to this latter group, either between test and control areas or over the three quarterly surveys (question 7I).

In TA(Hawthorne) and CA(Torrance), residents of both areas said that air pollution meant, among other things, noticeable odors. December survey results showed about 80 percent of the residents responded in this way, while in March and June the proportion exceeded 90 percent. Of those who responded that some component of air pollution was a problem in their area, more than half of the test area residents identified odors as a problem. Slightly better than one-third of control area respondents also gave this opinion. Noticeable odors received more mention in both test and control areas than did other components or effects of air pollution (question 5).

Effects of Odors Caused By the Paint and Varnish Factory. This source of neutral odor emissions was studied only in December. Test area responses closely paralleled those of the matching control area on most parts of question 7 relating to odors. The exception was in the response to the seriousness of the odor problem in that area of the city. About 60 percent of test area respondents indicated the odor problem was more serious than a year ago, while only a little more than 30 percent of control area respondents held this view. Since meaningful differences between test and control areas were not discovered, no further investigation of neutral odors was made. Results of other questions from these test and control areas are excluded from the findings reported in this chapter.

Effects of Odors Caused By the Bakeries. The effects of pleasant versus unpleasant odors were studied only in December and March. The December test and control areas were located in Glendale, while the March areas were in Beverly Hills. Significant differences were found between the responses in areas near the refinery and chemical plant on the one hand and the bakeries on the other. About three-fourths of the Glendale test and control area residents indicated that no odors had been noticed. In Beverly Hills, an even larger proportion of residents reported that they had not noticed odors. Sample sizes for all other parts of question 7 were too small to allow an evaluation of the attitudes about odors of residents of these test and control areas. It was concluded that no additional surveys of pleasant odors were warranted. Other findings from these test and control areas are omitted from this chapter.

Effects of Odors By Principal Areas Surveyed

As indicated in Chapter II, certain areas near the oil refineries and chemical plant sources were chosen to examine the effect of differing relative locations on survey results. These areas were also selected to investigate the results that might be obtained from the use of very small samples. Survey findings from all but two of these areas have been excluded from the results described below. Only the findings from TA(Hawthorne) and matching CA(Torrance) are reported. These test and control areas were most closely matched and were the only areas studied in each of the three quarterly surveys.

Social and Economic Effect of Odors. In order to determine whether odors had produced any economic effects, respondents who were home owners were asked whether they felt that odor pollution had reduced the value of their homes. Overwhelming percentages of both test and control area respondents replied that it had not. Consequently, other parts of the question relating to the degree to which home values had been reduced provided inconclusive data as the result of small sample sizes (question 9).

Both test and control area residents reported that houses in the neighborhood were sold usually within three months. However, a sizeable proportion of respondents did not know how long it took to sell a home in their area (question 10).

A hypothetical situation was posed to respondents bothered by odors where it would be possible to buy odor free air as it is possible to buy bottled water. They were then asked how much they would be willing to pay for such air. In both the test and the control area, more than two-thirds of the respondents replied that they did not know how much they would be willing to pay. It is speculated that the large proportion of such replies was caused by the newness of the idea of buying odor free air (question 8).

About three-fourths of the residents in both TA(Hawthorne) and CA(Torrance) reported that they had never considered moving away because of odor pollution (question 12). Approximately the same proportion indicated that they had not requested some authority or agency to take action concerning either odors or noise in their area (question 16). However, about half of the respondents said they would be willing to sign a complaint about these problems. Control area respondents were more willing to sign a complaint concerning noise than were test area residents. But, a much larger percentage of persons in both areas were willing to sign a complaint about odors. Only about one-third of the respondents said they were willing to appear in court to voice a complaint (question 17).

Residents were asked to consider the advantages and disadvantages for people in their area of the city and to indicate whether having odor producing industries nearby was good or bad. A sizeable percentage of respondents in both test and control areas felt this to be bad. However, a significant percentage of test area respondents replied that they did not know (question 11).

When asked how bad odors in a community might possibly affect the daily activities of residents, a variation over time was noted. In December, 65 percent of test area residents indicated that they did not know. In March, 15 percent gave this reply, while in June, only 6 percent did not know. Conversely, some effect on health was noted by a very small percentage of December respondents, by almost one-fifth during March, and by more than one-third in June. A similar pattern of test area responses was noted with regard to curtailment of outdoor activity. No pattern in control area responses emerged (question 13).

Slightly more than half of the respondents in both TA(Hawthorne) and CA(Torrance) indicated a strong odor had not forced them indoors in the December and March surveys. However, in the June survey more than 50 percent of the test area residents indicated they had been forced indoors while only 25 percent of control area respondents gave this reply (question 14). About three-fourths of the respondents in both the test area and the control area indicated that odors in the air had never made members of the family physically ill (question 15).

Neighborhood Conditions. Residents were asked to rate their area as a place to live. More than two-thirds of both test and control area respondents rated their area as either excellent or good (question 1). However, when asked whether they could think of any annoying things in the area that neighbors complain about, almost the same proportion replied affirmatively. An exception occurred in the control area during the June survey when only 48 percent gave a yes response. Complaints about air pollution or odors and noise were mentioned most often (question 2). Respondents were then asked to rate urban problems with regard to the seriousness of the problem in their area. Of the problems listed, only air pollution was rated as serious by a sizeable proportion of residents (question 3).

About three-quarters of the respondents indicated that there were no conditions in their neighborhood that would cause them to spend their leisure time inside their homes. Those saying that such conditions did exist identified odors most often. Cold weather or wind and noise were also mentioned by some residents. About 90 percent of all respondents said that there were no neighborhood conditions that would cause them to spend their leisure time away from home. Responses listing specific conditions were too few to permit evaluation (question 4).

As was previously mentioned, questions concerning noise were included in the survey in order to mask the real intent of the research. About 40 percent of both test and control area respondents said they had noticed noise in their neighborhoods. Of those noticing noise, a majority indicated that they had been bothered by it. Traffic and airplanes were frequently mentioned as the cause of this noise in the test area. Traffic also received a large percentage of the responses in the control area. In both test and control areas noise was considered to be a more serious problem than it was a year ago (question 6).

Demographic Data

From questions 18 through 24 a profile of the respondents to the three quarterly surveys can be drawn. Employed respondents tended to be white collar workers. Most respondents were between 35 and 64 years of age and had a high school education or better. The majority of respondents had annual family incomes of $10,000 or more.

Characteristics of Respondents

In order to determine if a relationship existed between the demographic characteristics of respondents and their reaction to odors, certain cross-tabulations were made. The responses to selected questions regarding odors were cross-tabulated with several demographic variables. These were respondents' family income, education, sex, age, and length of residence in Test Area A. The results of these tabulations are presented in Table 6.

A larger percentage of female respondents indicated they had noticed odors than did male residents. Fewer people over 50 years of age noticed odors than did those in other age groups. Also, a smaller percentage of persons having lived in the area for more than 15 years reported noticing odors.

Although the proportion of men and women who said they had been bothered by odors was nearly the same, nearly 10 percent more women than men were bothered very much or much by odors. Fewer respondents who were high school graduates or less indicated a willingness to appear in court to voice a complaint than did respondents with some college. Fewer persons over 50 years old said they would be willing to appear in court than respondents from other age groups.

SUMMARY

When questioned about odors, people tended to think only of unpleasant odors. In both test and control areas set up to study unpleasant odors, a sizeable proportion of residents noticed odors; however, the percentage of test area respondents noticing odors was significantly larger. A majority of residents who noticed odors were also bothered by them whether they lived in a test area or a control area, and most test area residents were able to identify the source of the odors. A sizeable percentage of residents who reported noticing odors felt that odors were a serious problem.

People were generally unaware of any adverse economic effects of odor problems, or they did not believe such effects exist. During the winter and spring a majority of respondents indicated they had not been forced indoors by odors, but in the summer more than half of the test area respondents said this had happened. Generally, people reported that odors had not made members of the family ill.

Using the formula for problem identification contained in the procedure manual attached to this report, it was found that odor problems did exist in TB(Torrance) in December and March and in TA(Hawthorne) in June. However, definition of the degree to which these problems had resulted in either adverse social or economic effects was generally beyond the capability of the respondents.

Table 6. Cross-tabulations of responses or combination of responses to questions by respondents' family income, education, sex, age, and length of residence in Test Area A.

Responses or Combinations of Responses	Family Income			Education		Sex		Age			Length of Residence		
	Less than $9,999	$10,000 to $14,999	$15,000 and more	High school grad. or less	Some college or more	Male	Female	18 to 34 years	35 to 49 years	50 years or more	5 years or less	6 to 15 years	16 years or more
Have noticed odors during the last three months	67%	71%	72%	67%	71%	58%	74%	68%	80%	56%	73%	74%	54%
Have noticed and been bothered by odors	55	77	79	72	80	75	77	77	71	43	76	74	81
Have noticed and been bothered very much or much by odors	48	64	69	64	62	56	67	65	68	53	53	82	53
Would be willing to appear in court to voice complaint	30	39	43	29	43	42	30	34	45	25	37	38	30

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CHAPTER V

TECHNICAL FIELD STUDIES

As a part of the national survey of the odor problem, an investigation was conducted of the utility of sensory techniques for documenting the intensity of odors. Two such techniques — vapor dilution measurements and odor judgment panel evaluations — were employed in this undertaking. The results obtained from both techniques were described and, to the extent of their use in the Philadelphia metropolitan area, compared. Although informative, the Philadelphia studies were not conclusive. So that the techniques could be used most appropriately, additional work comparing the operational features as well as the results was needed.

The present technical field studies were designed to provide such comparative information and to systematically measure the intensity, duration, frequency, and temporal variation of odors encountered particularly in Test Area A. The measurements were to be conducted concurrently with the public attitude surveys described in Chapter IV and analyzed to determine whether sensory techniques can be used to predict the existence of community odor problems.

This chapter is devoted to a comparison of the sensory techniques chosen. The first section describes the choice of techniques. The second and third sections deal with the application of the techniques chosen and the results obtained. The possibility of using such techniques as problem predictors is discussed in Chapter VII.

CHOICE OF TECHNIQUES

Because the present technical field studies were an extension of those performed during the national survey of the odor problem, only sensory techniques were used for odor analysis. Chemical and instrumental methods were not included in the national survey for two reasons:

(1) Odors in the ambient air around an industrial facility are caused by complex substances composed of many different odorants. Typically, such substances are present in such low concentrations as to defy chemical or physical analysis.

(2) Even though modern instrumentation has enabled some substances to be detected in the parts per million and even the parts per billion range, it is not known how to establish odor intensity levels from such analytical information.

In essence, the reaction between odorants and the olfactory receptor cells of the nose is not yet understood and, consequently, cannot be imitated. The most direct method available to study odors, therefore, is the human nose. Even with the disadvantages of the subjective nature of human evaluation and the possibility of fatigue to the senses, sensory measurements are generally most appropriate to the study of human response to odors.

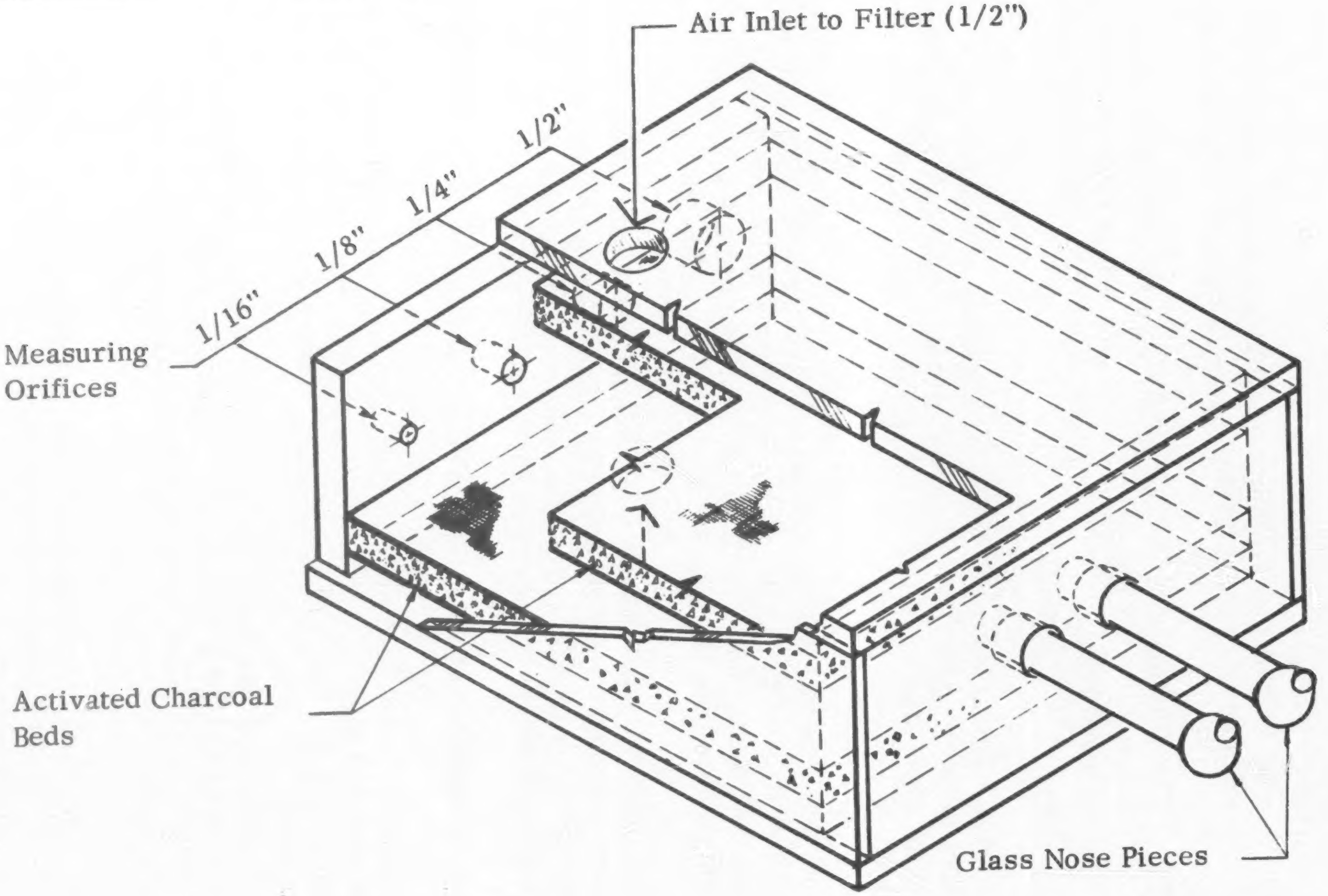
Most sensory techniques of odor measurement employ vapor dilution methods in which the odor is diluted with increasing volumes of odorless air until it is just discernible. These measurements can be made by collecting samples and returning them to the laboratory for dilution and testing, or preferably, by performing these tasks at the site of the investigation. Vapor dilution techniques are usually classed as static or dynamic methods. "Static" methods are those in which a sample is diluted physically by means such as syringes and then presented to an individual serving as an odor judge. "Dynamic" methods involve the construction of an apparatus which allows a particular sample to be mixed in any desired proportion with odorless air. By adjusting the flows of the sample gas and the odorless air, any dilution can be obtained and presented to the judge.

The simplest device of this type is the scentometer, which was developed by Norman A. Huey and his colleagues in the late 1950's. The scentometer is illustrated in Figure 7. The two bulb-shaped pieces shown in the figure fit to the operator's nostrils. Air is drawn into the device and nose as the operator inhales. When the four orifices (of diameters 1/2", 1/4", 1/8", and 1/16") are blocked, air is drawn through activated charcoal beds at top and bottom and is rendered odorless. By opening any one of the orifices, odorous air is drawn directly into the device by passing the filters, and is mixed with the odorless air. The four dilution levels thus obtainable are 2, 7, 31, and 170. These levels may be stated as scentometer "readings" of 1, 2, 3, and 4, respectively.

Major advantages of the scentometer are that the device is portable, having dimensions of 5" x 6" x 2-1/2" and that measurements can be made rapidly in the field. Versatility is sacrificed, however, as only four dilution levels are possible.

In contrast, a more sophisticated dynamic olfactometry apparatus is available to provide a continuous range of dilutions to threshold. Such apparatus, however, are more costly and, in some cases, not sufficiently portable to be carried into the field for direct measurements.

Figure 7. The Scentometer.


Air Inlet to Filter (1/2")
1/2"
1/4"
1/8"
1/16"
Measuring Orifices
Activated Charcoal Beds
Glass Nose Pieces

To attain desired portability, the scentometer was selected as the dilution to threshold device for this study. This choice was made despite certain difficulties anticipated in its operation.

The scentometer was thought to suffer from three major faults:

(1) An apparent insensitivity when compared to the unaided nose.

(2) The difficulty of sensing threshold levels, as uncertainty exists over a considerable range of odorant concentrations.

(3) The dilution to threshold values obtained are not a direct measure of the intensity of the odor before dilution because of non-linear relationships resulting from saturation of the activated charcoal.

To avoid such difficulties, a method involving an assessment of odor intensities without dilution was devised by Amos Turk. Reference standards are prepared from an odorant or combination of odorants having an odor which is characteristic of that produced by the source under investigation. The lowest standard intensity must be just above threshold, while the highest standard intensity must be above the strength expected to be encountered in the field. The number of standards in the series may range from 4 to 12, depending upon the range of odor intensities expected to be encountered and the ability of a human being to differentiate between adjacent members in the series.

Odor judgment panelists are selected and trained with the reference standards until they demonstrate a satisfactory ability to differentiate between the odor intensities. The panelists are then taken to the test area where they relate the odor intensity they experience in the ambient air to the standards with which they were trained. With this technique, rapid changes in odor intensity can be easily detected while odor levels are continuously recorded.

Because of its unique design for a direct assessment of ambient odors, the Turk method was chosen as one of the sensory techniques for this study. This technique was also believed to have three major drawbacks:

(1) The need to experiment with several different series of standards so that the reference chosen will closely match the odor caused by the industrial operation being investigated.

(2) The lengthy selection and training procedures necessary before the panelists were deemed qualified to evaluate odors in the field.

(3) The possibility of incurring considerable expense in preparing appropriate standards; selecting, training, and deploying panelists; and analyzing results.

The scentometer and reference standard techniques were recommended for additional study as a result of similar evaluations performed during the national survey of the odor problem. It was felt that the inclusion of these techniques in the present study would provide an opportunity to establish their relative utility for the identification and assessment of community odor problems. The further and more specific experience, however, revealed several hitherto unknown problems that inhibited comparison of the techniques and demanded resolution. These problems are described in following sections of this chapter.

APPLICATION OF THE TECHNIQUES

The Scentometer

The scentometer has been described by its developers and used by at least 12 local air quality agencies. Most of the descriptions have focused on the physical characteristics of the device and the principles of operation. Emphasis in this report is given to experiences gained from actual use.

Four scentometers were obtained from the Environmental Protection Agency and prepared for use in the technical field studies. Before going into the field, the orifices of each unit were blocked with tape in such a manner that they could be opened and reblocked repeatedly. Fresh charcoal was installed and was repeatedly checked to ensure that all odors were adsorbed by the beds.

Before use in the field, each scentometer was shaken gently in a horizontal position to distribute charcoal evenly over the beds, thereby eliminating the possibility of channeling. Each unit was also checked for leakage, particularly at the connection between the scentometer and the nose pieces. This was done by using each unit in an area of strong odor after blocking the four orifices. No discernible odor indicated no leakage.

Four representatives of Pope, Evans and Robbins were trained scentometer operators. Each operator was tested to have at least average odor sensitivity by triangle tests (similar to those described in the following section) and full understanding of operation. The following paragraphs characterize the technique employed in the field by each operator in Test Area A.

Upon arrival at a fixed station, each scentometer operator neutralized the effects of ambient odors by inhaling odorless air through the charcoal beds of the scentometer while keeping the four orifices blocked. When this was accomplished, the orifices were opened in turn until the operator could identify the smallest orifice through which the odor could be detected.

Unfortunately, this technique did not produce usable results for this study. The method may have been successful for more constant intensities of odor but, due to the transient nature of odors encountered in Test Area A, almost no scentometer readings were recorded. Huey recommended using the scentometer in a car. The application of the technique by a mobile operator was fairly simple and considerably more effective.

An odorized area was tentatively identified by a preliminary drive around the oil refinery and chemical plant. The operator then relaxed and inhaled odor free air, a procedure which required driving outside the test area, for the operator could not relax with the scentometer bulbs pressed against his nostrils.

When the operator was refreshed, the car was again driven through the odorized area. Throughout this drive the operator breathed through the scentometer with one selected orifice open. The route was immediately retraced with a different orifice unblocked in order to further define the odor intensity. Each time the route was traversed, the operator called out the points at which negative readings (when no odor was detected) changed to positive (when odor was detected), and vice versa. These points were plotted on a map of the area.

It may be appropriate to have four operators and a driver traverse the area in one car. In this way, with a different orifice open on each scentometer, an intensity value can be quickly determined. This requires only one trip through the area, with a return trip to verify the results.

This method, while it had successful results, entailed some problems. The automobile had to be well ventilated and maneuverable. For quick results, several people had to be in the car. If only one operator participated, the success of the technique depended upon the constancy of the odorous emission.

Although the mobile technique was found to be effective, the reasons for this were not fully understood. It can only be speculated that a plume of odor was more easily detected by the mobile scentometer operators because, with the effect of the relative velocities of the operator and the transient odor plume, the transition from no odor to appreciable odor was quite abrupt and noticeable. Also, conceivably, since the mobile operators surveyed a greater area, their chance of encountering an odor plume was increased. The stationary scentometer operators had less chance of encountering a plume of odor. Even if a stationary operator received a positive result through one orifice, up to a minute was needed to complete measurements with the remaining orifices. But, in a constantly changing odor environment, such time was seldom available. Indeed, in such an environment, it was difficult to feel certain that a positive result was obtained at all.

The Odor Judgment Panel

Twenty people were initially recruited for the December 1970 odor judgment panel. All were instructed that they would be tested on the first day and that, on the basis of this testing, 16 of them would be retained for the balance of the week. An attempt was made to employ a group similar in socioeconomic characteristics to the residents of Test Area A. However, because of the short term nature of the work, those attracted were mostly housewives, about 40 years of age.

Screening was conducted in accordance with the procedure of Wittes and Turk, using triangle tests based on odorous food flavoring extracts. The tests were simple to prepare, administer, and evaluate. While not a sophisticated screening procedure, the tests were quite adequate for excluding individuals with particularly insensitive or irrational responses to odors.

The equipment consisted of a supply of 2-ounce paper cups, water, and food flavoring extracts such as vanilla and wintergreen. The prospective panel members were subjected to a series of choices in which three paper cups containing solutions were presented to them. Two of the solutions produced identical odors, while the third produced a different odor. They were required to choose the paper cup containing the solution with the different odor.

Strongly scented samples perceivable to all or most of the candidates were used initially; then the concentration of extract used was gradually decreased in water toward the level at which 50% to 75% of them could detect the odor. As the tests were conducted over several hours, breaks were taken at regular intervals to avoid fatigue. A Barnebey-Cheney, Model ABB, activated carbon room purifier unit (4,000 cfm) was used to ensure the absence of ambient odor in the test room.

After each test, the scores were reviewed to ascertain the percentage of correct answers. A range of 50% to 75% correct answers was the target. If the actual percentage was outside this range, the concentration of odorants was readjusted. After 12 tests, the scores were reviewed in relation to the number of panelists required for the field studies. At this point, most of the candidates were accepted or rejected, although borderline candidates were subjected to further tests until a difference of two correct answers between them was achieved. The more successful were admitted to the panel. This preliminary screening process took a full day.

Triangle tests were again administered to select an additional 5 people for the March 1971 panel, since only 11 of the December panel members were available. Similarly, 6 people were recruited for the June 1971 panel. Of the 10 members of the March panel who were available, 6 had participated on the December panel. Although it was hoped that 16 panelists would participate each day, some absenteeism occurred. As a result, the panels varied from day to day from 13 to 16 members.

After recruiting and screening the panel, training with reference standards was undertaken. A non-toxic, stable standard was chosen that closely matched the oil refinery odor frequently encountered in Test Area A. Using various concentrations of this standard, the panel was trained to recognize the strengths of the odor with which they would be concerned. Tertiary dodecyl mercaptan was chosen as the standard. It was dissolved in mineral oil to give four solutions of varying strengths, as indicated in Table 7.

Table 7. Concentrations of tertiary dodecyl mercaptan in mineral oil used to simulate four strengths of refinery odor.

Rating	Concentration in Solvent (milliliters/liter)	Layman Assessment
1	0.125	slight
2	0.5	moderate
3	2	strong
4	8	very strong

The same room used to screen the panel was used for training purposes. The air was again purified during the training sessions. The standards were presented in capped, 4-ounce, polyethylene bottles with an insert to minimize the possibility of leakage caused by shaking the bottle.

Panelists were instructed to shake the bottle gently once or twice, remove the cap, and squeeze the sides once as they held the bottle under the nose. After a period of memorizing the different strengths and a few breaks to avoid fatigue, the panelists were invited to test themselves by removing a standard from the series at random and attempting to judge its intensity. During this time, the panel instructors circulated about the room and tested all panelists with unmarked samples. Prior to training, a few sets of standards were prepared on which the numbers were not clearly shown but were hidden on labels attached to the bottoms of the bottles. Panelists were asked to sniff the samples and to identify the strength of the odor.

The results of the December 1970 triangle and odor intensity tests are shown in Table 8. Individuals who scored higher than 6 on the triangle test were accepted. Those with a score of 5 or 6 were retested and accepted or eliminated based on the results of these additional tests. It is recalled that the odor intensity test consisted of judging a standard in relation to its proper position in a series of four strengths. The performance of any panelist who judged a standard more than one position away from its proper position was considered unsatisfactory.

Table 8. Results of triangle and odor intensity tests in preparation for the December 1970 field studies.

Candidate			Triangle Test		Odor Intensity Test	
Name	Sex	Age	Score (Pos. 14)	Decision	Score (Pos. 11)	Number of Times More Than 1 Away
A	F	42	8	accept	6	0
B	F	38	11	accept	6	1
C	F	50	5	reject		
D	F	42	6	reject		
E	F	45	9	accept	4	1
F	M	21	8	accept	7	1
G	F	36	12	accept	5	1
H	F	35	13	accept	5	2
I	F	45	13	accept	5	0
J	F	43	13	accept	5	0
K	F	46	8	accept	3	0
L	F	46	8	accept	4	0
M	F	51	8	accept	5	1
N	M	22	6	accept*	6	1
O	F	69	6	reject		
P	F	34	12	accept	6	0
Q	F	33	11	accept	5	2
R	F	33	5	accept*	5	2
S	F	42	8	accept	4	1

* After retesting.

When the results of the odor intensity tests indicated that the panelists were ready to go into the field, a briefing on recording procedure was conducted. Rating sheets were distributed on which panelists were instructed to record the highest intensity perceived during each minute of an evaluation.

The quality of the odor perceived was a constant problem. It was important that the odor judged was from the oil refinery. The instructions given to panelists concerning this were explicit. If the panelist was not sure whether the odor was from the refinery or not, he was to record the odor intensity and make a notation regarding odor quality. If the panelist was certain that the odor was foreign, i.e., not of refinery origin, he was instructed to record zero, as if no odor had been perceived. In all such cases, however, he was to describe the quality of the odor perceived.

Prior to panel selection and training, both sections of Test Area A were inspected, and suitable places to station panelists were selected. The locations were chosen in a systematic manner, so that panelists were approximately equally spaced, although possible stations near interfering odor sources, such as heavily traveled roadways, were avoided.

In addition to selecting 16 stations in each area, convenient places to perform panel calibration tests had to be found. The test area in this case was virtually ideal, for parks and a golf course were in proximity downwind. The parking lots of these places were used as calibration sites.

Panel calibrations were for the purpose of determining the variation between panelists. All panelists were placed at one station and instructed to record odor values independently for the same period of time. Independent observations were achieved by maintaining a distance of at least two yards between individuals.

There are no correct responses to calibration tests. Rather, they serve to identify variations among panelists' responses. As mentioned above, all panelists were placed at one station and instructed to record odor values for the same period of time. In theory, if a panelist regularly records data significantly different from the mean of the group, question arises concerning the accuracy of the dissenting panelist.

In practice, calibrations did not always work this way. Generally, when there was no odor, panelists agreed and consistently recorded zeros, as in Figure 8a. When, after a period of no odor and zero recordings, a noticeable odor suddenly appeared, this odor was generally perceived and recorded by all panelists. Figure 8b gives an example of this phenomenon.

Panelists were most varied in their results during calibrations in which odor presence and strength were questionable throughout. While panelists agreed on no odor and agreed on no odor followed by sudden odor, barely discernible odors upset their consistency. Some panelists believed no odor was present, some perceived slight or strong odors, and any variation in a vague, contestable odor provoked widely varied changes in intensity ratings. Figure 8c gives an example of this condition. (Note that from 2:28 p.m. to 2:29 p.m., panelist E recorded a change from 1 to 3, H recorded a change from 3 to 0, while K recorded no odor at all.)

After training the panel with the reference standards and testing the uniformity of their responses to actual oil refinery odors, the panel members were placed at their assigned stations throughout the test area.

To get 16 people to act as a unit and thereby avoid delays which reduce field evaluation time, a rigid adherence to schedule was required. It was observed during this study that about one hour was the optimum time to leave a panelist at work. The panelists' concentration, after working in solitude for an hour, seemed impaired. Therefore, a schedule was used similar to that recommended in Table 3 of the procedure manual attached to this report. When cali-

Figure 8a. Example of calibration test results when no odor was encountered in Test Area A.

Time	Panelist															
	A	B	E	F	G	H	I	J	K	L	M	N	P	Q	R	S
10:10 a.m.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:11 a.m.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:12 a.m.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:13 a.m.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:14 a.m.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:15 a.m.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 8b. Example of calibration test results when no odor was followed by sudden odor in Test Area A.

Time	Panelist															
	A	B	E	F	G	H	I	J	K	L	M	N	P	Q	R	S
10:35 a.m.	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
10:36 a.m.	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0
10:37 a.m.	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1
10:38 a.m.	0	0	0	0	1	0	0	1	2	1	0	1	0	0	0	2
10:39 a.m.	1	0	1	1	1	1	0	2	2	2	0	0	2	2	1	0
10:40 a.m.	0	2	2	2	2	2	2	2	1	2	0	2	2	2	2	2

Figure 8c. Example of calibration test results when odor was barely discernible or very transient in Test Area A.

Time	Panelist															
	A	B	E	F	G	H	I	J	K	L	M	N	P	Q	R	S
2:25 p.m.	1	0	1	1	1	0	1	2	0	1	1	0	0	1	1	0
2:26 p.m.	1	0	1	1	1	1	1	2	2	2	0	1	1	1	1	2
2:27 p.m.	2	2	2	2	3	2	2	2	2	3	0	2	3	2	2	2
2:28 p.m.	1	0	1	2	1	3	3	2	0	2	1	1	0	3	1	1
2:29 p.m.	1	0	3	1	0	0	1	2	0	3	0	1	0	1	0	0
2:30 p.m.	1	0	2	0	0	0	1	3	1	2	1	0	1	1	1	0

bration tests were thought necessary, they were included by reducing evaluation periods by 10 minutes.

RESEARCH FINDINGS

Scentometer Results

During the December 1970 field studies, scentometer measurements were taken using the stationary method previously described. The operators circulated among the odor panelists, taking scentometer measurements while the panelists recorded intensities based on their memory of the reference standards. Using this method, the operator consistently returned a series of zeros, despite odor judgment panel ratings of 1 and 2, i.e., "slight" or "moderate." These results were in accord with the results of the national survey of the odor problem and findings by other researchers.

Between the December 1970 and March 1971 field studies, laboratory experiments were also performed to investigate this phenomenon. It seemed likely that odors which were perceived in moderate strengths by panelists should be measurable using the scentometer with the largest orifice open. It is recalled that such a setting represents a dilution level of only 2.

A laboratory correlation between the scentometer and the odor panel was performed by the following steps:

(1) One scentometer operator stood ready to take a reading with a selected orifice unblocked.

(2) Another operator took one of four reference standards, shook it, removed the cap, placed the bottle under the open scentometer orifice, and squeezed, telling the scentometer operator to inhale at that time.

(3) The test was repeated using different orifices and different standards from the same series (tertiary dodecyl mercaptan).

The results obtained, using three of the four scentometer operators employed in this study, are given in Table 9.

As can be seen from these findings, scentometer results should be higher than those recorded by the odor panelists. For example, when the intensity of an odor is rated as 1 by odor panelists, a reading of 2 should be obtained with a scentometer. However, in field use, when such a rating was given by odor panelists, no readings (zeros) were obtained with the scentometer.

Table 9. Results of laboratory correlation obtained by taking scentometer readings of reference standards prepared for an odor judgment panel.

Odor Reference Standard	Orifice Open (Scentometer Reading) 1/2"(1)	1/4"(2)	1/8"(3)	1/16"(4)
1	+	+	-	-
2	+	+	+	-
3	+	+	+	+
4	+	+	+	+

+ indicates odor was detected; - indicates odor was not detected.

This apparent anomaly was investigated in detail during the March field studies. It became evident that the reason for the lack of positive scentometer readings was the transient nature of the odors encountered. Typically, an odor would traverse a particular site within a few seconds. During that time, it may have been sufficiently intense for an odor panelist to perceive and evaluate, but the scentometer operator was left in a state of confusion, unable to be certain of a positive reading and, thus, forced to record zero.

Using the mobile technique recommended by Huey, the results were consistent with those obtained with the laboratory correlation. To test the success of the mobile technique, a car containing two scentometer operators, two odor panelists, and a driver was used. During each trip through an odorized area, the scentometer operators recorded positive or negative results based on their scentometer settings, while the panelists recorded values judged against their memories of the reference standard scale.

In the June 1971 field studies, the mobile technique was used exclusively. Reliable measurements for particular areas at particular times were obtained. However, because the odors were so transient, it was difficult to get an accurate picture of conditions throughout Test Area A over long periods of time. An example of area surveillance by mobile scentometry is shown in Figure 9.

Odor Judgment Panel Results

A typical odor panel result sheet is shown in Figure 10. As a rule, panelists made few, if any, comments. In cases where comments were noted, they were generally of the type included in the figure.

Panelists returned two to four result sheets per day in the field. All results were tabulated and analyzed by the panel administrators. Two figures emerged for each station and evaluation period: (1) the percentage of time odor was detected, and (2) the mean intensity of that odor. These figures were summarized for each of the technical field studies. Summary tables of the December, March, and June studies in each section of Test Area A are provided in Appendix

Figure 9a. Example of odor intensity readings obtained by mobile scentometry during morning traverse of Test Area A.

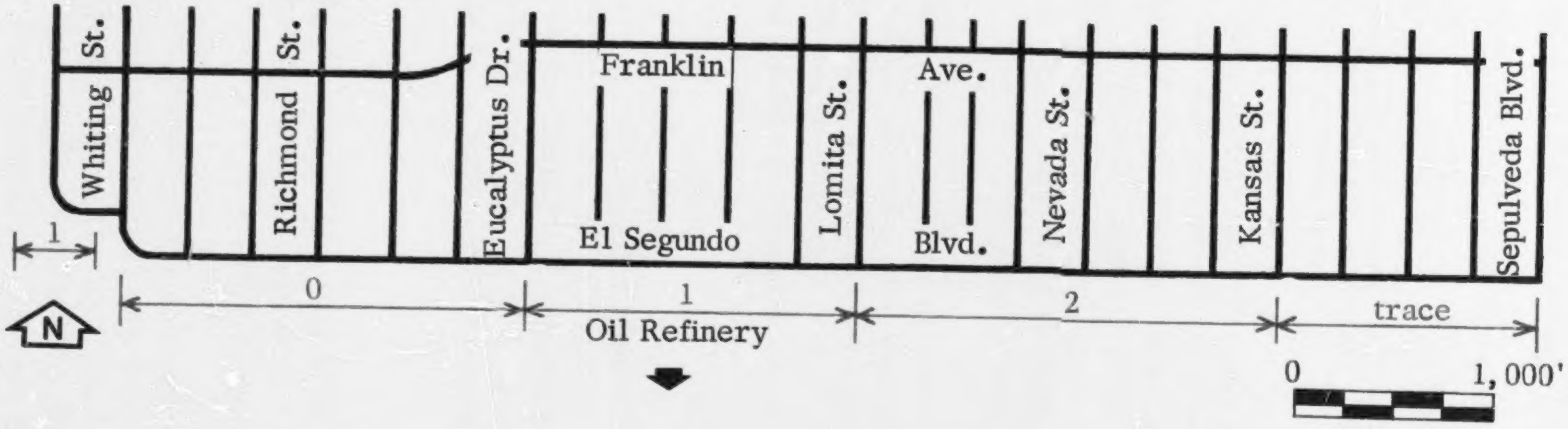

Whiting St.
Richmond St.
Eucalyptus Dr.
Franklin
El Segundo
Lomita St.
Ave.
Blvd.
Nevada St.
Kansas St.
Sepulveda Blvd.
1
0
1
2
trace
Oil Refinery
N
0
1,000'

Figure 9b. Example of odor intensity readings obtained by mobile scentometry during afternoon traverse of Test Area A.

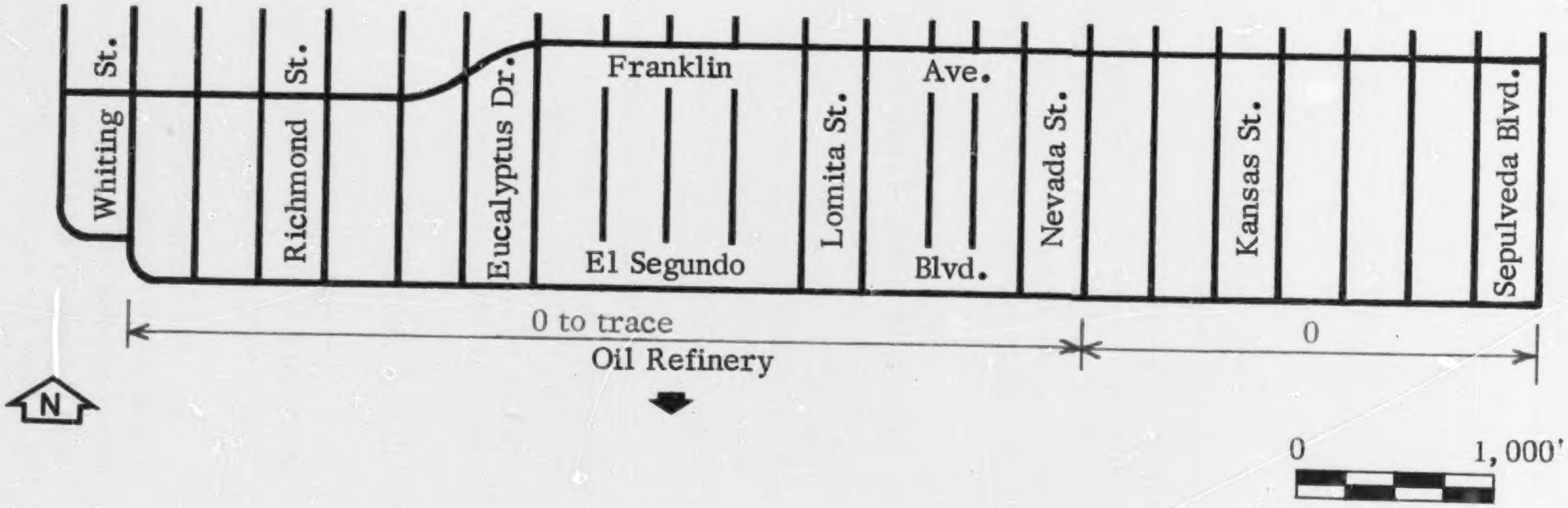

Whiting St.
Richmond St.
Eucalyptus Dr.
Franklin
El Segundo
Lomita St.
Ave.
Blvd.
Nevada St.
Kansas St.
Sepulveda Blvd.
0 to trace
0
Oil Refinery
N
0
1,000'

Figure 10.

ODOR INTENSITY RATING SHEET

NAME Jane Doe

DATE 6-18-71

LOCATION Golf Course
Indiana & Franklin

LOCATION Eucalyptus &
El Segundo

TIME	RATING	COMMENTS	TIME	RATING	COMMENTS
	Calibration Test:			Evaluation Period: Eucalyptus &	
		Golf Course			El Segundo
9:42	2		10:33	1	
43	1		34	3	
44	1		10:35	2	
9:45	.5		36	3	
46	.5		37	3	
47	.5		38	2	
48	.5		39	2	
49	0		10:40	.5	
9:50	0		41	.5	
51	1	Auto exhaust	42	0	
52	0		43	.5	
53	.5		44	.5	
54	.5	Auto exhaust	10:45	0	
9:55	.5		46	2	
56	1		47	1	
57	.5		48	1	
58	.5	Auto exhaust	49	0	
59	0		10:50	.5	Manufacturing type odor
10:00	.5		51	2	
	Calibration Test:		52	3	
		Indiana & Franklin	53	1	
10:06	0		54	0	
07	.5		10:55	0	Wind shifted NW
08	1		56	0	
09	0		57	0	
10:10	.5		58	0	
11	0		59	0	
12	2		11:00	0	
13	2		01	0	
14	0		02	1	
10:15	.5		03	0	
16	0		04	0	
17	0		11:05	0	
18	1		06	.5	
19	2		07	0	
10:20	0		08	0	
10:21	1		09	.5	
10:22	2		11:10	0	

Note: .5 indicates that odor was detected, but was not of sufficient intensity to be rated as 1.

D. Maps depicting mean odor intensities and percentage of time odor was detected at each March and June panelist location are also provided in Appendix D. It is noted that the mean odor intensity and percentage figures are 4-day averages.

SUMMARY AND CONCLUSIONS

The main purpose of the technical field studies was to monitor malodors in Test Area A for subsequent use in determining relationships between odor intensity and community reaction. During the early part of the field studies, it became apparent that modifications to the measurement techniques described in the national survey of the odor problem were necessary to obtain accurate odor intensity data. Using these modifications, the reasons for the seemingly poor correlation between the scentometer and odor judgment panel results reported in the national survey were identified. Subsequently, a more realistic laboratory correlation was obtained and verified in the field.

When odors were transient, it was essential to use the scentometer from a mobile platform. Because of the rapidly changing conditions, a stationary operator was often unsure whether or not he had obtained a positive reading. Consequently, a great number of zero findings were recorded at fixed stations. In contrast, the mobile measurements were successful. This required measuring intensities along the perimeter of the odor source under investigation.

The technicians employed as scentometer operators were known to have satisfactory triangle test results. During the laboratory and field tests, when two operators took readings simultaneously, invariably the same result was obtained as long as both operators were certain odor was discernible. Some differences did occur when the dilution brought odor intensities down to barely discernible levels (i.e., when one operator was not sure if odor was present and the other was unable to detect it). Positive results were recorded only when the observers were certain they could detect odor, and because of this practice, differences between operators performing measurements under the same test conditions were rare.

The odor judgment panelists were selected on the basis of triangle test scores and then trained with selected odor reference standards for a day before going into the field. The training improved panelists' abilities to discriminate between odor intensities in the laboratory, but during calibration tests in the field, some panelists gave results that varied greatly from the mean. This suggested that the initial screening and subsequent training may have been inadequate. A longer selection and training process, including field calibration tests, might have produced more uniform responses. Application of correlation factors, based on calibration test results, to normalize panelists' scores was not feasible because of the limited data and widely fluctuating field conditions.

A major advantage of the odor panel technique is that readings are made simultaneously throughout the area under investigation and that a definite pattern of odor intensity distribution over the area can thus be obtained. This is only true, however, if the distance between panelists is not too great. During the national survey, one panelist was at each street intersection throughout the odor affected area. This arrangement was optimal, but few panelists were needed since the areal extent of the odors was small.

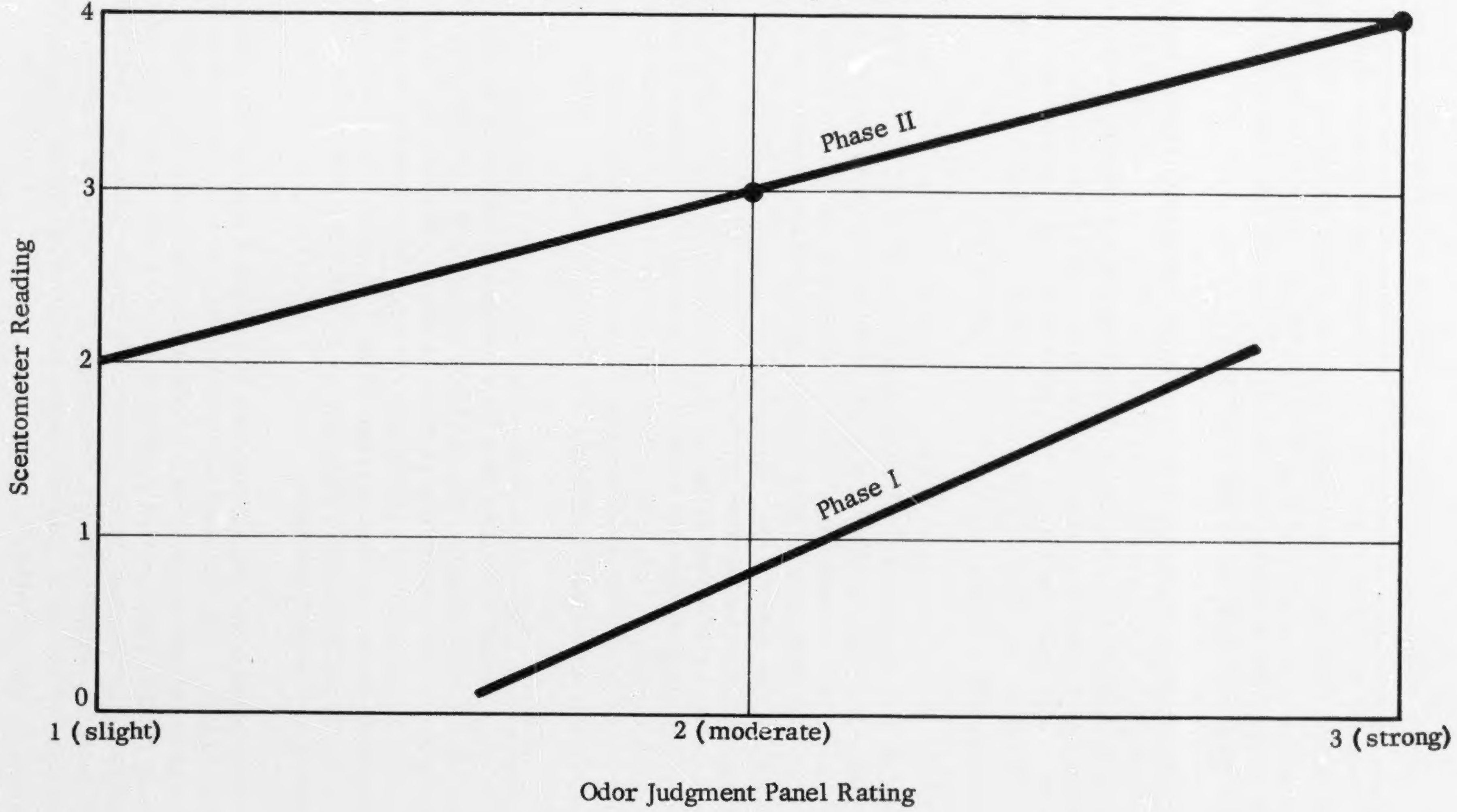
In the present study, the area was large, while only 16 panelists were budgeted for use. Two possibilities existed — either to move the panel so that the area was divided into a series of small areas with panelists on each corner or to place the 16 panelists throughout the area. The latter procedure was necessary in this study because of the nature of the data required for odor problem identification, but the large distances between stations did not provide sufficient data to plot a definite pattern of odor intensities.

If the odor reference standard technique is to be used as a general means of enforcing odor regulations, a considerable amount of work is still necessary. Investigation of an odor problem at short notice may require the availability of a large number of reference standards. The stability of the standards over long periods needs investigation. Panel training and logistics require a few days before a panel can be operational. Because of the number of people involved, this becomes a lengthy and expensive procedure. The most efficient use of the odor reference standard technique is not as a tool for routine surveillance, but as a means for gathering substantial evidence against offenders who will not cooperate with local authorities. This technique is particularly applicable to those circumstances where legal liability or compliance questions require explicit documentation of an odor emission or absolute verification of an odor source.

Correlations between odor panel and scentometer readings are illustrated in Figure 11. It should be noted that the relationship developed during the national survey of the odor problem was based on actual field measurements of odor intensities by the two techniques, at fixed locations, whereas the relationship provided by the present study illustrates the laboratory correlation of odor reference standards to the scentometer (see Table 9 above). The latter relationship was verified in the field under transient odor conditions when the scentometer was used from a mobile platform.

The intent of the laboratory exercise was to illustrate that the scentometer was improperly characterized as an insensitive device in the report on the results of the national survey. Although the transiency of the odors encountered may render it insensitive at fixed stations, it was found quite adequate for discriminating among odor intensities from a mobile platform. Because it can be used to defatigue the operator when odors are of constant intensity and long duration, the scentometer may be a more sensitive technique than an odor judgment panel in such situations.

Figure 11. Correlation of scentometer readings and panel ratings developed during the national survey of the odor problem (Phase I) and the present study (Phase II).



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CHAPTER VI

ECONOMIC EFFECTS OF ODORS

This chapter describes an investigation of the economic costs attributable to the presence of industrial odors in a community. Principally, the discussion is confined to a comparison of single family property values in a test and control area. Two brief sections comprise the remainder of the chapter. The first of these discusses the economic consequences of an odorized environment on industrial property and activities. The final section lists other economic effects of odors and the difficulty that must be overcome for such effects to be properly assessed.

Discussion of single family property values is centered on an evaluation of various sources of real estate sales data and an analysis of sales trends in both TA (Hawthorne) and CA (Torrance). For each source, the accuracy, coverage, and problem of obtaining the data are documented. Analysis of the data by the following operations is fully explained:

- Calculation of average sales prices by half year for the period 1965 through 1970.
- Development and application of deletion rules for investor purchases and extreme values.
- Comparison of single source average sales prices with combined sources figures.
- Determination of average home value growth rates for each area and the significance of the differences found.
- Comparison of turnover rates for each area.

As a conclusion to this section, various hypotheses are critically evaluated in light of the data compiled.

The results of interviews with representatives of major firms in the test area are offered as implications of the economic consequences of odors on industrial firms. Included among these interviews was one with a manager of a large industrial park immediately east of the principal odor source. A diversity of other economic effects and the need for data to substantiate such possibilities are also mentioned.

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SINGLE FAMILY PROPERTY VALUE EFFECTS

While a review of past studies concerned with air pollution effects on property values is not fully warranted here, a cursory examination is appropriate since most of the assessment techniques used in these studies were considered in the design of the present project. To date, all studies done on the relationship between air pollution and property values have considered air pollution in terms of dustfall, sulfation rates, and suspended particle concentrations, but not specifically odors. Yet, at the outset of this project, there appeared to be no reason why this variable could not be added, if only sufficient data were available.

The basic premise in most air pollution/real estate studies is that "... in a competitive properly functioning completely interdependent general equilibrium system, all economic losses due to air pollution are capitalized into property values."[1] It is further generally assumed that buyers regard land and structure as a bundle, not as separate entities. Finally, "for pollution to result in differential property values, buyers need only know that they prefer some properties to others and, other things being equal, are willing to pay more for the preferred properties."[2] These primary assumptions plus other theoretical considerations were most completely set forth by Crocker in his 1970 study of Chicago property values using FHA data.

By far the favorite technique applied to economic effects research is multiple regression. Ridker and Henning used this technique in a cross-section study of St. Louis. Property value and other demographic data were drawn from the 1960 Censuses of Population and Housing and used on a census tract basis. Pollution data were drawn from air quality agency sampling stations and interpolated to obtain values for census tracts without stations. Crocker and Anderson, in their 1969 study, eliminated most of the specification problems of the Ridker and Henning study and reworked the St. Louis data through an improved model. They also applied Kansas City and Washington, D.C., data to their model with good results.

Crocker's 1970 comprehensive study of Chicago embodied another major advance — viz., switching from ex ante offer price data to ex post sales data. In addition, he was able to avoid making the heroic assumption that response error to the Census question on property value was both random and, on average, offsetting. Evidence on the validity of this point was skimpy, as Crocker noted. Detailed information collected on two census tracts for the Chicago study did not offer much support for this common contention.

Another technique for assessing the impact of air pollution on property value is through the use of professional appraiser judgments. While this method, employed by Stradbeck, is undoubtedly less sensitive than regression analysis, it should yield differences if they exist and are large enough.

As the focus of this study was on odor problems rather than on air pollution in general, modifications in the approaches of previous studies had to be made. First of all, a cross-section technique was judged to be unfeasible. It required the existence of an odor problem over a sizeable area for which various intensities of odors could be measured. In reality, most odor problems of a continuing nature exist only over a relatively small area (usually over 1 to 5 census tracts).

A time series regression analysis over a test and control area initially appeared to be feasible. Adequate property value information seemed to be available, and both analytical and complaint data from the air pollution control agency serving Los Angeles County could have been used as a proxy for odor intensity in the test area. However, the research team was denied access to the necessary air pollution data and, consequently, was unable to employ this technique.

If the presence of odors in an area does have a negative impact on home values, the impact should manifest itself in slower growth in home prices, at least at the outset of the problem. Thus, an examination of property value growth rates provides another method of assessment — the one adopted for purposes of this project. This method could be applied in two ways. First, if a control area that is homogeneous with the test area, except for odors, could be located, then the growth in home values could be calculated for each area during a particular period and compared to isolate the influence of odors. Secondly, if enough data on multiple sales (the same property sold several times) were available in each area, then the difference in average change in value could be determined. This tack necessitates a number of homes being bought at about the same period of time and held for roughly the same number of months. While sufficient multiple sales might not be found, compilation of the data would aid in an analysis of turnover rates.

Despite the difficulties involved in a growth rate approach, it was hoped that using a good control area would obviate some of the usual problems. In addition, it would employ accurate *ex post* sales data similar to that used by Crocker in the Chicago study.[3] Another consideration was that with good sales data for the first half of 1970, a spot check could be made on the accuracy of 1970 census tract home value figures. Finally, collecting individual property sales data over time from several sources would permit a rather complete assessment of the accuracy and coverage of each source.

Description and Evaluation of Data Sources

Of the several pairs of test and control areas examined in this project, the growth rate analysis has been limited to TA(Hawthorne), a residential development known as Holly Glen (C.T. 6023 — incorporated portion only), and CA(Torrance), known as Southwest Park (C.T. 6505 — except extreme western end).

Holly Glen and Southwest Park are both products of single developers, and are typical of the better grade housing developments constructed during the mid-1950's. Both developments offered homes in three floor plans with conventional concrete foundations, stucco exteriors, composition shingle roofs, three bedrooms, and two-car garages, all on 5,000 square foot lots. Initially, the Holly Glen homes contained between 1,100 and 1,150 square feet and had 1-3/4 baths[4], whereas the Southwest Park homes had the same square footage, but only one bath. In addition, the Holly Glen homes featured built-in ranges and ovens, whereas the Southwest Park homes did not. Real estate salesmen operating in Southwest Park felt it was a quality area. However, several admitted the lack of a second bathroom lowered sales prices by "several thousand dollars." This feature undoubtedly explains most, if not all, of the approximately $3,000 or 11 percent price difference between the two developments.

Residents in both areas seemed to be pleased with the quality of the local schools. A quality education at low cost is possible in both areas, mainly because of extensive industrial taxable property located within each area's school district boundaries. One of the major selling points of both areas is their location in relatively smog free portions of the Los Angeles basin.

As illustrated in Figure 12, all of the Holly Glen development is contained within a single census tract and lies entirely within one corporate city limit. The same is true of Southwest Park, except this development extends a few blocks across Del Amo Boulevard to the south of the census tract. Because of differences in the demographics of this extension, the blocks were not included in this study. During 1969, a new development was constructed on vacant land west of the north-south portion of Norton Street. Because of the dissimilarity of these new homes to the majority of homes located in Southwest Park, they were deleted from the control area.

Real Estate Office Data

Initially, an attempt was made to acquire home sales data for both the test and control areas by contacting individual real estate firms. A complete census of all homes for sale in January, 1971 was conducted in both TA(H) and CA(T) to determine which real estate offices were actively engaged in selling property in these areas. In Holly Glen, 13 homes were for sale by 9 real estate dealers. Of these, only two had more than one home for sale in the area. In Southwest Park, 29 homes were for sale by 17 real estate firms. Here, the market was a little more concentrated, as 4 companies had 14 homes on the market. Unfortunately, no realtor dealing in TA(H) was also selling in CA(T). One realtor in Holly Glen explained that established offices generally confine their activity to within a radius of two miles. Costs of business licenses as well as the need for real estate board memberships in several cities were probably confining factors.

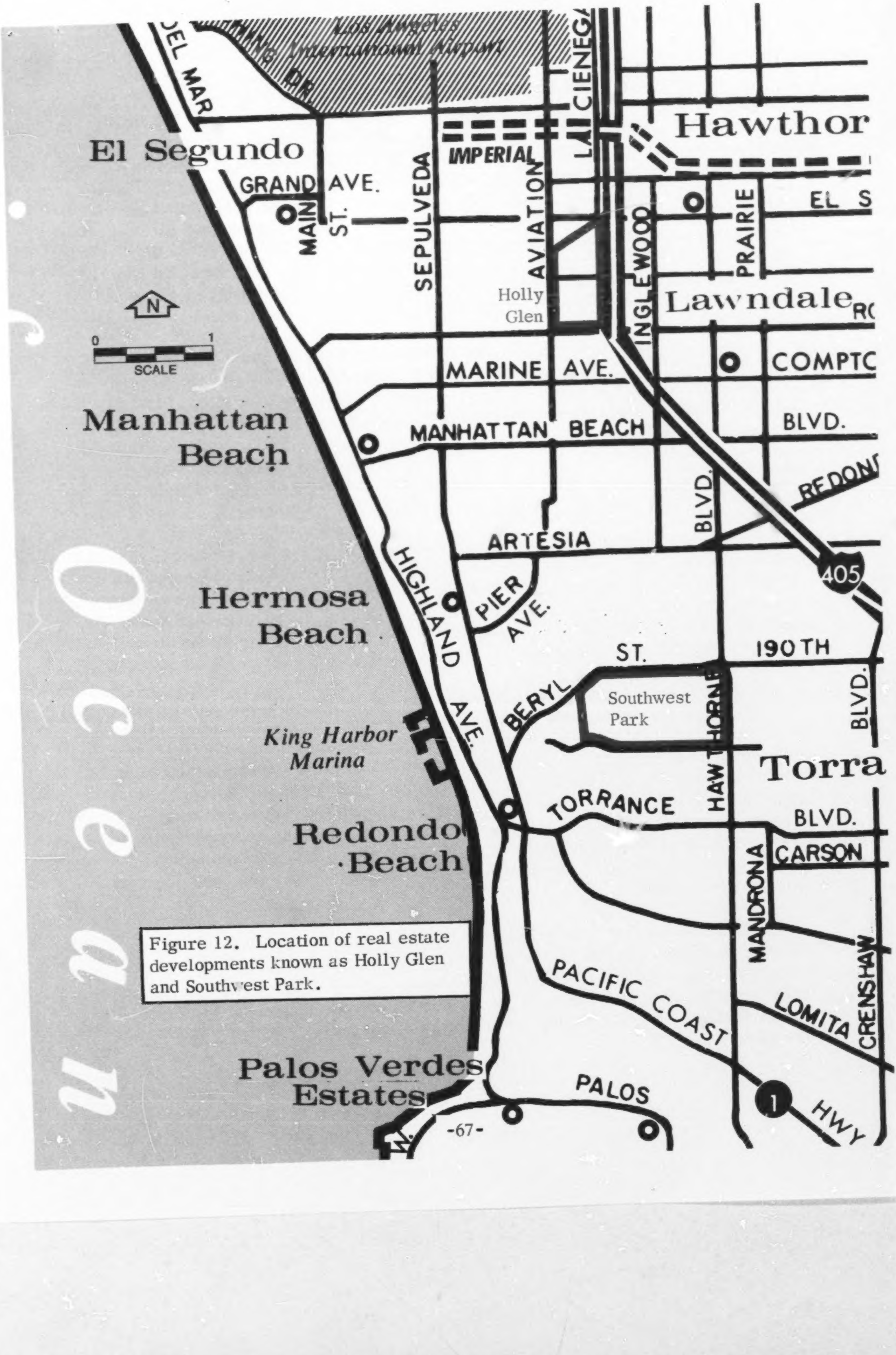
Los Angeles International Airport
DEL MAR
VISTA DEL MAR
IMPERIAL HWY.
DR.
El Segundo
GRAND AVE.
MAIN ST.
SEPULVEDA
IMPERIAL
AVIATION
LA CIENEGA
Hawthor
INGLEWOOD
PRAIRIE
EL S
Holly Glen
Lawndale
N
0
1
SCALE
MARINE AVE.
COMPTC
Manhattan Beach
MANHATTAN BEACH
BLVD.
BLVD.
REDOND
ARTESIA
405
Hermosa Beach
HIGHLAND AVE.
PIER AVE.
ST.
190TH
BERYL
Southwest Park
HAWTHORNE
BLVD.
Torra
King Harbor Marina
TORRANCE
BLVD.
Redondo Beach
CARSON
MANDRONA
CRENSHAW
PACIFIC COAST HWY
LOMITA
1
Palos Verdes Estates
PALOS
Ocean

Figure 12. Location of real estate developments known as Holly Glen and Southwest Park.

Seven of the 9 real estate dealers in Holly Glen and 6 of the 17 firms, including the 4 largest, in Southwest Park were contacted. Most of the real estate dealers were able to offer estimates of what homes sold for in their area of operations and by how much homes were annually increasing in value. In Southwest Park, the average figure quoted agreed closely with the average calculated later in the study. However, in Holly Glen, the realtors consistently quoted a figure roughly $1,000 below the average determined later. Some real estate dealers were able to recall instances where specific homes were sold more than once during the 1965-1970 period of interest. The extent of such data depended entirely on memory, as the brokers did not keep records in such a way as to permit compilation of this type of information.

Multiple Listing Data. A more productive way of collecting property value data was to obtain multiple listing sales often tabulated by the local board of realtors. Several problems were encountered in using this source. First of all, the extent of coverage of homes sold varied, depending on how aggressively the board of realtors pushed the multiple listing service. For example, in Holly Glen, coverage was fairly good during 1968-1970, but was quite poor during 1965. During the entire 1965-1970 period under investigation, the multiple listing data for Southwest Park appeared to be much more complete.

Another problem found with multiple listing data was that reported sales may not be final sales. In several instances, the same house would be sold twice within three or four months and not necessarily for the same price. It was discovered that such situations resulted primarily because the buyers could not qualify for loans at the agreed upon prices. These particular situations did not cause much problem, except that, occasionally, the final sales were not reported.

A final disadvantage associated with the use of multiple listing data was that some boards did not compile and publish the sales data gathered by their multiple listing service. This was the case in El Segundo. While the Hawthorne-Lawndale and Lomita-Torrance boards of realtors compiled and published multiple listing sales data, it was not generally available to the public. After it was explained that Copley International Corporation wanted the data for a "community problems" study, the Hawthorne data was made available. However, the Lomita-Torrance board refused access to their information, explaining it was for use by members only. Nevertheless, most of these data were later acquired from other sources.

It should be noted that multiple listing data do have certain advantages. First, they always list the date of sale rather than close of escrow, as is customary in other sources. Second, selling price, street address, and listing price are also always included. Finally, number of rooms, number of bedrooms, square footage, lot size, number of bathrooms, and garage size are sometimes provided.

SREA Data. Another source of sales data for single family homes in the test and control areas was the Society of Real Estate Appraisers. These data have been published for Los Angeles and other cities in the United States since 1967. As the name indicates, the purpose of the data is to assist real estate appraisers. It is a subscription service offered only to those firms engaged in regularly making first mortgage loans on single family homes. As a part of the subscription price, subscribers are required to provide sales and property description information on each loan approved. Sales price is exact, but close of escrow rather than sale date is given.

The primary advantages of this source of information over the multiple listing data were that it provided a complete description of the property sold, the date the home was built, and, generally, a more complete coverage of total sales in an area. As with the multiple listing data, sales involving assumptions of existing loans include the sales prices of the properties involved.

Comps Data. Starting in mid-1967, Comps, Inc., began tabulating home sales data from public records on a monthly basis. Sales price can be estimated by tabulating the transfer tax paid. Since the source of these data is the County Recorder's Office, almost 100 percent of the sales are listed. Completeness is this source's greatest virtue.

This publication also has several shortcomings. Again, the distribution is limited to property appraisers and lenders. However, the data are usually sold to persons engaged in legitimate research. No details about a property, such as square footage, number of rooms, existence of a swimming pool, etc., are provided.

Using the title transfer data to obtain usable sales information involves four major problems. First, price can be determined only to the nearest $500. Second, any transfer involving the assumption of an existing loan requires a transfer tax only upon the balance of the loan, not on the total price of the home. Third, as with SREA data, the close of escrow date is the only date provided. Finally, approximately 15 percent of all transfers financed by either conventional loans or assumptions of existing loans represent sales to investors with only the investor's address being listed. This means if an investor living in Holly Glen buys a single family home either in or outside of Holly Glen and uses conventional financing, he may list his Holly Glen residence address as the point of contact on the deed.[5] This is not as serious a problem as it first appears, however. Since Comps publishes this property sales data every six months, it is likely that the investor's address will appear several times, even if he is only moderately active. Thus, he can be identified.

Evaluation of Sources

To meaningfully compare the coverage of the last three sources listed above, the test and control areas had to be analyzed separately. Because multiple listing, SREA, and Comps data were not all three available for a complete year until 1968, the evaluation of sources was done only for 1968 through 1970. Since many listings from each source were found not to be actual sales or the sales price could not be determined for reasons explained above, coverage percentages have been listed on two bases: (1) Total Listings, i.e., all home sales listed by each source, and (2) Usable Listings, i.e., only those transfers that actually took place and for which the sales price could be determined. In a final column for each basis, all three sources were combined, but the same sales reported in more than one source were counted only once.

It can be seen in Table 10 that the multiple listing percentage of usable listings in Holly Glen increased in both 1969 and 1970. Indeed, in 1970 its per-

Table 10. Single family home sale coverage in Holly Glen (1968-1970).

Year			Multiple Listing	SREA	Comps	All Three Combined*
1968	Total Listings:	#	15	27	77	84
		%	18	32	92	100
	Usable Listings:	#	12	21	36	43
		%	28	49	84	100
1969	Total Listings:	#	21	33	61	73
		%	29	45	84	100
	Usable Listings:	#	14	26	40	42
		%	33	62	95	100
1970	Total Listings:	#	18	15	40	53
		%	34	28	75	100
	Usable Listings:	#	9	9	15	19
		%	47	47	79	100
Three Year Totals (#) and Averages (%)						
	Total Listings:	#	54	75	178	210
		%	26	36	85	100
	Usable Listings:	#	35	56	91	104
		%	34	54	88	100

Note: No deletion rule applied within any source.

* Same sales reported in more than one source counted only once.

Source: Lawndale-Hawthorne Board of Realtors; Comps, Inc.; SREA Market Data Center; Copley International Corporation.

centage matched that of SREA. This largely reflects the Lawndale-Hawthorne Board of Realtors' success in expanding the multiple listing service. SREA and Comps show some variation but exhibit no definite trend.

Usable listings' percentages in Southwest Park, Table 11, show no trend for any of the three sources. Of note here is that the SREA and the multiple listing sources offered roughly the same coverage.

Table 11. Single family home sale coverage in Southwest Park (1968-1970).

Year			Multiple Listing	SREA	Comps	All Three Combined**
1968	Total Listings:	#	30	36	63	79
		%	43	51	90	100
	Usable Listings:	#	26	32	44	49
		%	53	65	90	100
1969	Total Listings:	#	40	27	60	69
		%	58	39	87	100
	Usable Listings:	#	33	22	35	46
		%	71	48	76	100
1970	Total Listings:	#	16	20	40	48
		%	33	42	83	100
	Usable Listings:	#	11	13	26	27
		%	41	48	96	100
Three Year Totals (#) and Averages (%)						
	Total Listings:	#	86	83	163	187
		%	46	44	87	100
	Usable Listings:	#	70	67	105	122
		%	57	55	86	100

Note: No deletion rule applied within any source.
* Data for first half of each year only. Multiple listing data not available for second half of each year.
** Same sales reported in more than one source counted only once.
Source: Lomita-Torrance Board of Realtors; Comps, Inc.; SREA Market Data Center; Copley International Corporation.

Comparing the three year averages at the bottom of each table reveals two important points. For usable listings, Comps provided the same coverage in both areas, approximately 87 percent. Similarly, SREA's coverage was constant but 30 percentage points lower than that of Comps. Multiple listing coverage of one third for one area compared to three fifths for the other was not surprising according to real estate experts. Coverage by SREA was also reported to fluctuate from county to county, varying directly with the percentage of lending institutions subscribing and providing loan data.

Examination of the ratios of usable listings to total listings disclosed considerable variation between sources and areas. In Holly Glen, less than 50 percent of the total listings were usable in calculating average prices. One third of the multiple listing sales either were not completed or were sales to investors where only the investors' addresses were listed. For the SREA sources, only one fourth of the sales were not usable for these reasons. Almost half of the Comps recorded sales were not usable because they were sales to investors and, more important, because the sales involved assumptions of existing loans for which the sales prices were not available.

A similar picture emerged in Southwest Park, except only 20 percent of multiple listing and SREA data were not usable. Almost two thirds of the Comps information was usable. Hence, for the area as a whole, 65 percent of all observations were usable for average price calculations.

A check on the accuracy of sales price and date of sale for each source was possible because of a large number of sales which were reported by more than one source. Price accuracy for multiple listing data in both Holly Glen and Southwest Park was generally good. There were only two instances out of 105 where the multiple listing price was off by more than $1,000. In all other cases, the price differences were less than $500. In only two instances out of 123 were SREA prices in error. However, one figure was in error by $8,000. This undoubtedly was a reporting error, because adding the recorded down payment to the stated selling price yielded the actual price.

Comps data proved to be the most inaccurate, mainly due to the nature of the recording system. Sales price is reported indirectly in terms of IRS tax stamps affixed to the deed transfer. A tax rate table must therefore be used to translate the dollar amount of tax stamps into sales price.[6] Since $500 units are used in determining the transfer tax due, sales price can be determined only to the nearest $500. This is not a severe problem because most single family homes are sold for multiples of $500 (over 70 percent, as calculated in this study). Secondly, a home selling at the top end of a deed transfer tax bracket pays the tax on the lower bracket. For example, a home selling for $29,000 pays the IRS transfer tax based on the $28,500-$29,000 bracket, not on the $29,000-$29,500 interval. Thus, in 71 percent of the Comps sales, the true sales price was determined by using the highest value of the IRS tax stamp implied sales price category. In 77 percent of the cases, this method would yield a price within $100 of the actual price. (These comments on Comps' prices are restricted to sales not involving assumptions of loans. As mentioned above, an assumption involves a tax upon only the amount of the loan assumed and not on the entire sales price.) The latter percentage is probably the more correct, since SREA rounds its sales figures down to the nearest $100, e.g., $28,995 would be reported as $28,900. Multiple listing data is rounded normally to the nearest $50.

How much bias did this interpretation procedure of Comps' sales data impart to the average price of a home? Of more than 200 sales listed by Comps and also reported by at least one other source, the average upward bias was $47. By deleting four selling price errors (each found to exceed $1,000), the average bias was reduced to $38. It should be noted that, while this bias was small for the three year period as a whole, it was much larger for any six month period in which an error was found.[7]

Multiple listing source data provided the exact date a home was sold. These dates were accurate with the only apparent chance of error being typographical.

Dates provided by SREA were generally loan approval dates. However, since these dates were supplied by different institutions, they were sometimes the dates of sale and sometimes the dates of recording or close of escrow. Analysis of sales recorded by both sources showed that, in 90 percent of the cases, the month of sale listed in the SREA report was the same month or the following month as that recorded by multiple listing; that is, usually the loan was approved the same month or, at worst, the month after the sale occurred.

Comps' reported date, of course, was the close of escrow or recording date. In almost half of the cases, this date occurred by the end of the month following the month of sale. Thus, for all houses sold during June, almost 50 percent had been recorded by the end of July. In only three percent of the cases did the recording occur more than four months after the month of sale.

No discussion of real estate sources would be complete without mention of the Federal Housing Administration, the Veterans Administration, and the California Department of Veterans Affairs (Cal-Vet). Since these organizations decide on borrowers' qualifications for the loans they finance and/or guarantee, each possesses a wealth of information on sponsored home purchases. However, individual sales data are generally not available due to confidentiality requirements. This is not to say that the data are completely beyond research use, since, for example, Crocker was able to utilize FHA Chicago data in his study.

How accurate are the data and how good is the coverage? Sales price and date of sale information should both be exact from all three sources. Coverage by each source may vary tremendously. To ascertain the likely range of coverage in the Los Angeles metropolitan area for these latter sources, a random sample of sales was drawn from the Comps books on southwest Los Angeles County. For each of the 1,736 sales listed, the type of financing was noted. To make the resulting loan distributions more informative, they were recomputed, eliminating foreclosures and assumptions.

Table 12. Distribution of home loan types in Southwest Los Angeles County.

	All Deed Transfers		New Loans Only	
	Percent	Normal Range	Percent	Normal Range
FHA	4.2%	2- 6%	9.5%	5-15%
VA	10.2	7-14	23.3	18-30
Conventional	28.6	26-30	65.3	55-75
Cal-Vet	0.8	0- 1	1.9	1- 2
Assumption of loan	54.5	50-60	--	--
Foreclosure deeds	1.7	1- 2	--	--
Total	100.0%		100.0%	
Total no. of transfers	1,737		759	

Source: Comps, Inc.

From Table 12 it is obvious that Cal-Vet would be of little use in property value investigations. If the area of study were large enough, FHA information might be adequate. Clearly, VA data would be the preferred source of the three because the VA accounts for one tenth of all home financing and almost one fourth of all new home loans. It is doubtful, however, that even VA data would have been adequate for areas as small as those investigated in this project.

Average Price Calculations

Originally, the plan was to tabulate average, single family home prices for each area on a quarterly basis. Due to the lack of sufficient sales data, especially in TA(Hawthorne), home sales averages had to be compiled on a semi-annual basis. Had Comps data been available for the entire period, perhaps quarterly averages would have been possible, although the sample sizes in TA(H) would have been small.

Initially, sales data as far back as 1960 were sought so that the long term trend in home value appreciation could be ascertained. It was hoped that deviations in the trend caused by the presence of odors in Holly Glen during 1968 through 1970 would stand out. As stated above, SREA and Comps data were not available prior to 1967. Multiple listing data for Holly Glen were not published until 1965. Thus, the availability of data dictated that the period of study be 1965-1970 and that averages be compiled by half years.

To tabulate a mean sales price for each half year, all three published sources were used. This was done in order to maximize the sample size and thereby reduce sample variability. Prior to the second half of 1967, all multiple listing and SREA sales were included in the average price calculations. For a sale to be used after June 1967, it had to have been recorded by Comps. The purpose of this rule was to delete all those sales which, for one reason or another, either were never completed or went to real estate investors. Uncompleted sales were excluded because they represented ex ante market transactions rather than the desired actual, ex post sales. Investor sales were not wanted because they did not represent final consumer sales and because the property sold may have been located outside of the test and control areas. Home transfers from investors to non-investor type buyers were included in determining average sales price because such sales were for final consumption.

One criticism of the above methodology is that the data used for the period January 1965 through June 1967 were not entirely comparable to the data used from June 1967 through December 1970. However, to make the data entirely comparable, only the multiple listing source could have been used. It was thus felt that any loss in comparability over time using the outlined procedure was more than compensated by the increased number of observations in Southwest Park and, particularly, in Holly Glen.

In order to discover which properties had been sold more than once during the period of investigation and to facilitate matching the same sales reported by more than one source, all home sales were recorded on index cards and then sorted by address. It was at this stage that investor type sales became apparent. In one case, the same home appeared to have been sold 8 times in a period of 15 months. However, reference to the buyer's name (which is provided in Comps) showed the same person was the buyer for each sale. Based on an analysis of the frequency of occurrence, every property listed in Comps showing two deed transfers within four months was checked to determine if the buyer's name was the same. In almost all cases where investors were involved, the sales data were not included in the analysis. However, if the same house was sold several times with the same buyer's name referenced on all but the last sale, then the data for the last sale were included.

Where the same sale was recorded by either the multiple listing and/or SREA, this information was transferred to the Comps card. Duplicate sale cards were thus removed. The remaining cards were then sorted into half year periods. For reasons discussed above, date sorting was done by multiple listing dates whenever possible. When not available, an SREA date was used if it indicated the sale in an earlier period than did the Comps date. If only the Comps final recording date was available, it was assumed that a July date represented a sale during May or June and thus belonged in the average calculated for the year's first half. Similarly, January recordings were included in the average calculated for the second half of the previous year. From an analysis of actual sales dates and transfer dates, this rule was judged to be conservative as actual sales dates were probably at least 6 weeks older than the dates listed in Comps. Any bias arising because of the one month rule used was judged as negligible.

At this point, mean home sales price was calculated for each half year in each area. The range of sales prices for each average was also determined. In both areas, the lower end of the price ranges stood at about 85 percent of the mean prices. Similarly, the highest prices averaged 124 percent of the mean home sales price in Holly Glen and 152 percent in Southwest Park.

Close examination of the range price to average price ratios drew attention to four extreme prices. Common sense indicated that one price was in error and represented an investor purchase of property outside Southwest Park, since it was triple the average maximum price for the control area. In addition to this $99,500 home sale, another was found to have sold for $69,500. Since this was twice as high as any other maximum in the control area, it also was thought to be an error or an investor purchase. Both sales were deleted from the analysis.

In Holly Glen, a $45,000 sale reported on the multiple listing sheets was found to be $4,500 higher than the next highest sale, while another sale at $16,500 was determined to be $3,500 below the next lowest. Two realtors were contacted who dealt in the test area; both asserted that the listed prices were in error.

Eliminating these four sales and recomputing the range price to average price ratios produced an average minimum price of 86 percent and an average maximum price of 123 percent of the mean home sales price.[8] Using these percentage relationships, the following deletion rule was developed to deal with extreme values: In a homogeneous area, calculate the mean ratio of range price to average price. Multiply the signed difference from one of these two resulting ratios by 2.5 and added to one. Any home transfer having a sale price to average price ratio greater or lower than the resulting limits should be deleted. By applying this rule to the present study, the upper and lower limits were found to be 1.6 and 0.6, respectively.[9]

Such a rule is quite liberal in retaining extreme values, for it says to retain any sale as long as it is no more than 160 percent greater than the average sales price. A similar statement holds for minimum values. By this rule, all four suspicious values described above would be removed. Of the retained home sales figures for both areas combined, the lowest range price to average price ratio was 0.7; and the highest, 1.5.[10] The necessity of such a deletion rule for extreme observation is made clear by the following example. Including the $69,500 home sale in Southwest Park for the first half of 1969, the average price of homes in the control area would have increased by $900, even with a sample size of 46!

The purpose of calculating average home sales prices was to estimate market determined average prices of all homes in the test and control areas. Since it was the pattern of growth of these averages that was important to quantify the economic effects of odors, extreme observations were obviously not wanted even if they represented valid sales in the areas. Thus, the above deletion rule, operating in both directions, eliminated not only incorrect and out of area sales, but also the extreme tails of the sales price distributions.

After editing, as just described, mean sales price by half year was calculated for the test and control areas. The results are displayed in Table 13 To better compare the relative growth rates of the two areas and eliminate the $3,000 price differential, the average price data were converted to an index basis with the second half of 1965 (II, 1965) set equal to 100. These index data have been graphed in Figure 13. With a sample size of only 3, the value for the first half of 1965 (I, 1965), in Holly Glen, has been omitted.

The peculiarly sharp rise and fall in average price in Holly Glen between II, 1966 and II, 1967 was at first thought to be due to extreme values. The distribution for I, 1967 was skewed to the right, but not as severely as expected. Using medians instead of means raised II, 1966 by $250 to $26,000 and lowered I, 1967 by $1,000 to $27,100. The median for II, 1967 was $26,500 or less than $200 below the mean. Each of these median values is represented in Figure 13 by an "x."

Single Source Averages. What real advantages have been achieved by editing the three sources into one set of figures upon which an average was calculated? Specifically, suppose only one source had been used with no editing; how would the averages thus computed differ from those obtained? To answer this question, Tables 14 and 15 were compiled for Holly Glen and Southwest Park.

In Holly Glen, the multiple listing based averages range from $1,300 above to $1,500 below the corresponding averages for the combined sources. Averages for 1967 and 1968 are above whereas 1969 and 1970 figures are below those for the combined sources. SREA averages are uniformly low. Comps based averages range from $3,360 below to $900 above those for the combined sources.

Contrasted to the Holly Glen multiple listing based averages, those in Southwest Park are uniformly higher than the corresponding averages for the combined sources. In the first half of 1970, this difference exceeds $2,000. Averages based on SREA data are almost uniformly above those obtained from the combined sources, but the differences are always less than $1,000. Curiously, this is the exact reverse of the situation in Holly Glen. Except in two consecutive periods where the Comps based averages were high by $2,000, the Comps averages very closely matched those for the combined sources.

Applying the deletion rules described above to the single source data would undoubtedly bring the averages much closer to the figures developed from the three sources combined. However, in dealing with very small areas such

Table 13. Average sales price of homes in Holly Glen and Southwest Park for half year intervals (1965-1970).

Year/Period		Holly Glen No. of Sales	Holly Glen Mean Price	Holly Glen Price Range	Southwest Park No. of Sales	Southwest Park Mean Price	Southwest Park Price Range
1965	I	3	$32,730	$23,700-$39,000	48	$22,530	$20,000-$26,500
	II	8	25,200	21,500- 27,000	38	22,930	21,000- 27,900
1966	I	8	26,480	20,000- 34,500	31	23,220	21,000- 27,500
	II	7	25,740	25,000- 26,800	5	23,800	22,500- 27,000
1967	I	14	28,240	24,000- 36,500	37	23,600	17,000- 30,500
	II	32	26,670	21,000- 32,500	46	24,540	21,500- 27,000
1968	I	25	27,680	25,000- 39,000	49	25,370	22,000- 30,000
	II	18	28,630	23,000- 37,500	38	25,690	23,000- 31,000
1969	I	22	29,380	25,000- 38,500	46	26,850	22,000- 40,000
	II	20	29,080	25,900- 34,300	36	26,620	22,500- 34,000
1970	I	10	30,690	27,950- 40,500	27	27,450	21,000- 33,000
	II	9	31,570	28,500- 34,500	25	27,880	25,000- 34,000

Source: Lawndale-Hawthorne Board of Realtors; Lomita-Torrance Board of Realtors; Comps, Inc.; SREA Market Data Center; Copley International Corporation.

Figure 13. Mean price of homes in Holly Glen and Southwest Park, 1965 - II = 100.

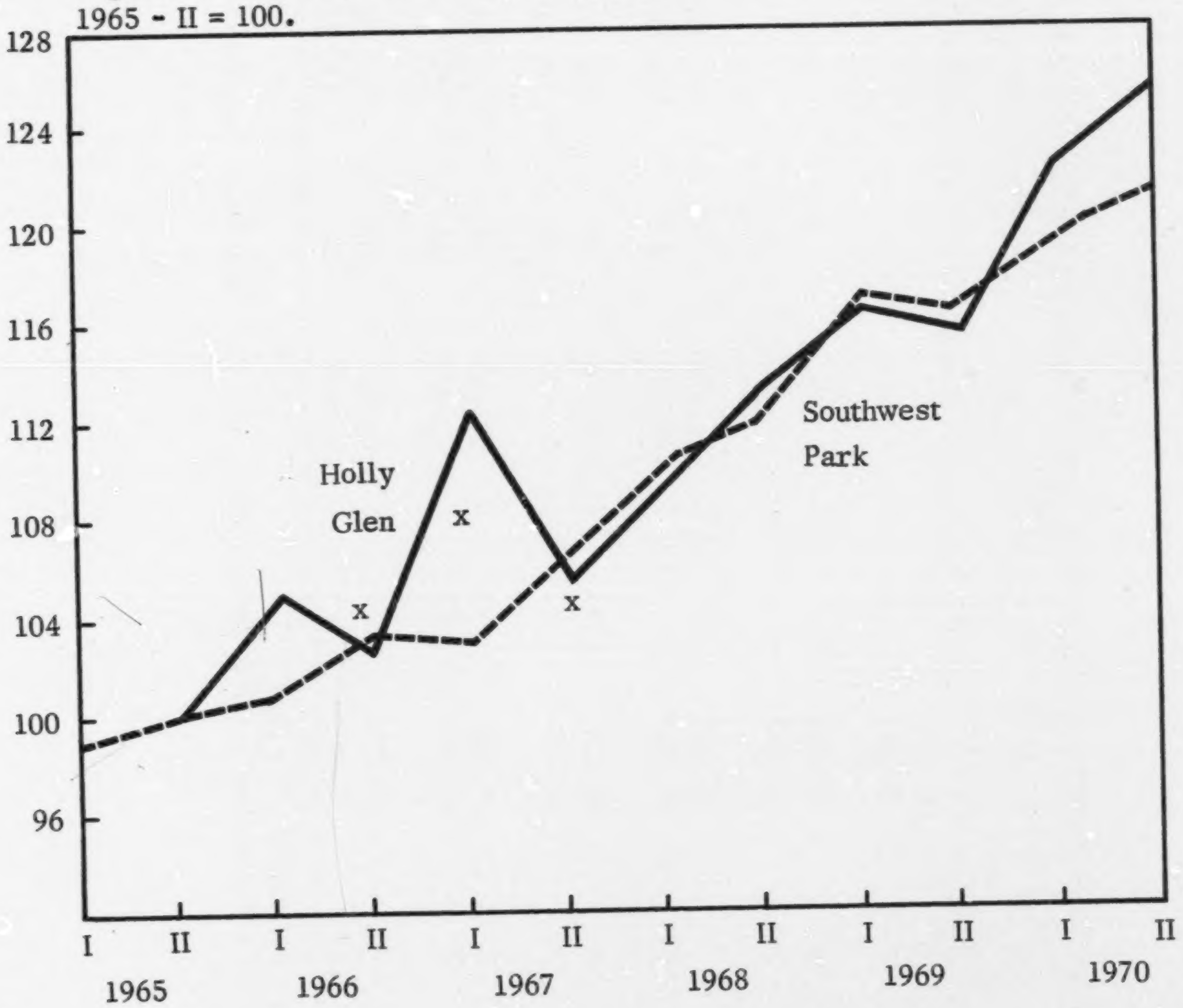

Table 14. Average sales price of homes in Holly Glen by single source for half year intervals (1965-1970).

Year/Period		Multiple Listing		SREA		Comps		Actual Avg. Price	
		No. of Sales	Mean Price	No. of Sales	Mean Price	No. of Sales	Mean Price	No. of Sales	Mean Price
1965	I	3	$32,730	--	$ --	--	$ --	3	$32,730
	II	8	25,200	--	--	--	--	8	25,200
1966	I	8	26,480	--	--	--	--	8	26,480
	II	6	25,700	--	--	--	--	7	25,740
1967	I	5	29,100	8	26,680	6	29,670	14	28,240
	II	5	27,700	9	28,110	33	26,210	32	26,670
1968	I	8	29,160	15	27,010	27	24,320	25	27,680
	II	6	29,510	12	28,390	16	28,620	18	28,630
1969	I	14	29,320	15	28,290	22	29,090	22	29,380
	II	7	28,790	18	28,600	21	29,900	20	29,080
1970	I	8	29,370	12	30,880	10	27,500	10	30,690
	II	10	31,170	3	28,900	8	30,310	9	31,570

Note: No deletion rules applied to data.

Source: Lawndale-Hawthorne Board of Realtors; Comps, Inc.; SREA Market Data Center; Copley International Corporation.

Table 15. Average sales price of homes in Southwest Park by single source for half year intervals (1965-1970).

Year/Period		Multiple Listing		SREA		Comps		Actual Avg. Price	
		No. of Sales	Mean Price	No. of Sales	Mean Price	No. of Sales	Mean Price	No. of Sales	Mean Price
1965	I	48	$22,530	--	$ --	--	$ --	48	$22,530
	II	38	22,930	--	--	--	--	38	22,930
1966	I	31	23,220	--	--	--	--	31	23,220
	II	5	23,800	--	--	--	--	5	23,800
1967	I	37	23,820	4	23,420	12	23,670	37	23,600
	II	7	24,120	12	25,120	45	24,460	46	24,540
1968	I	30	25,440	36	25,760	44	25,520	49	25,370
	II	13	25,940	24	25,710	36	27,740	38	25,690
1969	I	40	27,360	27	26,860	37	28,720	46	26,850
	II	15	27,130	26	26,780	36	26,590	36	26,620
1970	I	16	29,280	20	28,340	26	27,550	27	27,450
	II	1	34,000	13	27,650	24	27,690	25	27,880

Note: No deletion rules applied to data.

Source: Lomita-Torrance Board of Realtors; Comps, Inc.; SREA Market Data Center; Copley International Corporation.

as the ones under investigation, the resulting loss of observations could be critical. For large areas, Comps would be the best single source. (These data are available from Comps on computer tape.) While SREA does not have the coverage of Comps, the data are in better form for area analysis. Comps simply lists sales by street address, whereas SREA lists sales by map reference and then by street address within the area referenced. (This information is also on computer tape.)

Analysis of Average Price Data

If the presence of odors has an effect on property values, then, other things equal, average home prices should grow at a slower rate in an odor affected community than an odor free community. This assumes not only that other things remain equal during the period of comparison, but also that the odors are sufficiently evident in the odor affected community and absent (or at relatively low intensities) in the odor free (or relatively odor free) community to permit measurement of the effect. The validity of this hypothesis was tested by comparing the growth rates of average sales price in Holly Glen (TA(Hawthorne)) and Southwest Park (CA(Torrance)). It was expected that average sales price in Holly Glen was growing significantly slower than in Southwest Park.

Over the five year period from II, 1965 through II, 1970, mean sales price in Holly Glen increased 25 percent as compared to 22 percent in Southwest Park. These figures represent average (compound) annual growth rates of 4.6 percent and 4.0 percent, respectively — exactly the reverse of what was expected.

Since odors were thought to have become a problem in Holly Glen during 1968, growth rates were examined before and after this date. From II, 1965 to I, 1968, mean sales prices expanded at an average annual rate of 3.8 percent in Holly Glen and 4.1 percent in the control area. During the problem period, from I, 1968 through II, 1970, average sales prices accelerated in the test area to 5.3 percent a year and slowed to 3.8 percent a year in Southwest Park.

To arrive at an average annual dollar growth rate, a simple regression line was fitted to the data in both areas. In Holly Glen, mean sales prices increased at an average rate of $572 per half year period or $1,144 a year. The corresponding figures for Southwest Park were $509 and $1,018. As would be expected, the regression lines fitted the data very closely.[11]

It is noted that an analysis of only multiple listing and SREA data indicated reverse trends. The implication is that average sales price variations are quite sensitive to the quality of the data.

An explanation of the results is that the odor problem was too transitory to be capitalized into property values. Complaints from Holly Glen residents became severe only during 1969 and early 1970. Indeed, by late 1970, as discussed in Chapter II, the apparent odor problem greatly diminished.

A more cogent explanation is probably that the technique itself was simply not sensitive enough to detect the small dollar effects likely in this particular study. The percentage growth rates were based solely on the end points. As was seen earlier, adding one extreme figure, even to fairly large sample sizes, could shift the average by several hundred dollars. In addition, the variances of the observations that make up the averages are not small. This is dramatized by the range of sale values shown next to each average listed in Table 13.

It is possible that some other factor having a different impact on the test and control areas could have swamped any effect of odors on the growth of property values. For example, with each community in a different city, differences in property tax rates conceivably could have had such an impact. Investigating this possibility, it was found that the total tax rate grew 23.0 percent between 1965 and 1970 in Southwest Park and 21.6 percent in Holly Glen. Between 1965 and 1968, the tax rate increased 3.8 percent in Holly Glen, but only 0.8 percent in Southwest Park. In the 1968-1970 period, the tax rate rose 17.1 percent in the test area versus 22.0 percent in the control area. Though the differences were small, they are in the right direction to support the differential in property value growth rates in the two areas. But, because these tax rates are so similar[12] and have grown similarly, it is doubtful that they explain the noted different growth rates in average sales prices. This contention was supported by the difficulty encountered by the research team (and, undoubtedly, by potential buyers) to obtain the tax rate figure at all.

It may be noted that the number of homes sold in II, 1966 and I, 1970 exhibited significant drops from earlier periods. This phenomenon was simply a reflection of two tight money periods in which home mortgage money was extremely scarce. However, these events should have had no effect on the average price of homes sold as the impact would be uniform in both areas.

Turnover Rates. Another effect of odors in an area could be an increased turnover rate. This stems from an hypothesis that the presence of odors may cause sufficient annoyance to homeowners to impel them to move from the test area.

To investigate this possibility, the number of units sold per 100 units per period was calculated for both Holly Glen and Southwest Park. No discernible pattern was uncovered, as Table 16 indicates. It could not be determined why the turnover rates in Holly Glen were generally lower than in the control area.

Table 16. Turnover rates of homes per 100 units.

		Holly Glen	Southwest Park
1965	I	0.3	2.5
	II	0.7	2.0
1966	I	0.7	1.6
	II	0.6	0.3
1967	I	1.2	2.0
	II	2.8	2.4
1968	I	2.2	2.6
	II	1.6	2.0
1969	I	1.9	2.5
	II	1.8	1.9
1970	I	0.9	1.4
	II	0.8	1.3

Note: Holly Glen contains 1,141 homes and Southwest Park, 1,895.
Source: Lawndale-Hawthorne Board of Realtors; Lomita-Torrance Board of Realtors; Comps, Inc.; SREA Market Data Center; Copley International Corporation.

A new odor problem might not cause a long term resident who has built up strong ties in the area to move, but it might provoke a newcomer to leave. To test this possibility, those homes sold at least twice during the 1965-1970 period were analyzed. Of those who moved into Holly Glen between 1965 and 1968, 68 percent moved out during the 1968-1970 period. In Southwest Park, the corresponding percentage was 62. These two percentages were not significantly different at the five percent level.

COMMERCIAL AND INDUSTRIAL EFFECTS

The opinions of retail businessmen about odors in their communities were studied as part of the national survey of the odor problem. As a group, the businessmen were less concerned than the residents of the same communities about odors. Only 8 out of 138 businessmen (6%) interviewed in odor affected (test) areas felt that odors had a negative effect on their businesses. Of these, only 2 (less than 2%) felt that the presence of odors had reduced the annual revenue of their businesses by more than 10 percent.

Since no retail firms or apartment houses were contained in either Holly Glen or Southwest Park, no comment can be made as to the economic impact of odors on such establishments. In general, the type of analysis used for single family residences would be almost impossible to apply in either case. This is due to the difficulties which would be encountered in matching apartment or retail businesses in the test and control areas. Secondly, the success of either type of business depends to a large degree on the competence of management. Finally, the probable absence of large numbers of firms in both areas would deny the canceling effect of large numbers.

Several industrial parks are located between the oil refinery and chemical plant complex and Holly Glen. Many firms have located in the parks small, non-polluting manufacturing facilities and sales offices. To ascertain if any of these facilities had suffered losses due to odors, it was planned to interview the managers of the two largest firms and at least one of the industrial parks. The management of one of the firms would not talk with the research team because they were considering litigation against one of the odor sources. A discussion with a representative of the other firm proved more fruitful.

This person asserted that, on several occasions, employees had left the plant because concentrations of hydrogen sulfide in the ambient air had drifted into the building and the odor had made them ill. Although this situation occurred several times, he stated that no tabulation of employees leaving because of the odors was kept. Nevertheless, he felt that employee productivity was lowered on days when this gas entered the plant, but no documented studies had been performed.

It was found that two of the industrial parks in the area between the odor sources and Holly Glen were managed by the same person. In response to questions by the research team, the manager stated that the older of the two parks was developed between 1956 and 1964. Though both the oil refinery and chemical plant were in existence long before 1956, he claimed no problem was experienced until 1969. One of the companies which leased facilities in the older park was the firm considering litigation. He stated that, beginning in 1969, when concentrations of hydrogen sulfide and sulfur dioxide became high, the company experienced damage to their equipment and products. And, like the other firm, employees had experienced sickness resulting in some absenteeism.

The manager implied that odors may have caused difficulty in financing, constructing, and leasing facilities in the newer industrial park. For example, representatives of various lending institutions have commented on the unpleasant odors and taste experienced in the area. They have mentioned that effects of contaminants in the air can be felt on the face and seen on construction steel being used in the park. These conditions may have influenced the decisions of lenders against the park developers with regard to the availability or terms of development financing. In addition, the construction companies working on the park have experienced absenteeism that could be related to the presence of odors. Finally, although potential leases have not stated that they would not locate in the park because of the odors, the manager felt that the almost constant presence of objectionable smells must have been considered a negative factor to some.

Unfortunately, no information has been gathered which could provide an economic measure of the effects of odors on either of these industrial parks. The difficulties discussed above represent possibilities based on sheer speculation.

It seems likely that the lack of economic impact information would be encountered generally throughout the United States for two reasons:

(1) Although existing neighbors of odor causing industrial operations are offended and do incur damage, they do not choose to publicize the fact beyond the courts of law.

(2) There has been little attention given to the collection of detailed cost data that would make an evaluation of such an impact possible.

OTHER ECONOMIC EFFECTS OF ODORS

The possibility that odors cause health effects is currently being investigated by other research organizations.[13] If relationships are found, then odors could have economic consequences in the form of medical, hospital, and other related costs. Unfortunately, no evidence of such consequences could be located.

Odors could adversely affect tourism. However, there was no tourism to speak of in the test area. Public beach areas were located immediately west of the oil refinery. Since the prevailing breezes were in a westerly direction, this area was rarely bothered by odors. Once again, no records were kept on beach attendance which might provide a base for assessing an economic impact.

The tax base of the area could have been lowered by the presence of odors. But, since the available methods were not sensitive enough to detect any fall in single family property values, no effect on the tax base from residential properties could be calculated. Slower development of the industrial parks may have caused the tax base to grow more slowly, but no dollar figure could be attached because of inadequate records. In short, economic effects seemed possible, but they simply could not be quantified within the scope of this study.

SUMMARY AND CONCLUSIONS

If odors have an economic effect on homes, it should be capitalized negatively into the price of the property. The major approach used in this project to quantify such effects was to compare the growth rate of average property values in closely matched test and control areas. Four major sources of data were located:

(1) Real estate offices
(2) Multiple listing publications
(3) Society of Real Estate Appraisers
(4) Comps, Inc.

Although real estate offices kept sales information for various periods of time, it was generally not made available to the research team. Multiple listing information offered exact sales price and date, but lacked good coverage. SREA data offered better coverage, but loan approval rather than sales date was provided. Comps information, based on deed transfer records, provided 100 percent coverage, but price data was missing for roughly 40 percent of the transfers included. Comps provided transfer dates but not sales dates. The difference in time between the two dates averaged one to two months. Prices could be determined from Comps only in increments of $500.

Average home sales price was tabulated by half year from 1965 through 1970. All of these sources were combined to obtain the most accurate and complete data. Extreme sales data were eliminated, as were investor type sales. Comps and SREA data were available beginning with the second half of 1967. Hence, the sales price averages calculated for II, 1967 through II, 1970 were based on larger sample sizes than were the averages for I, 1965 through I, 1967. The combined sources averages calculated for I, 1968 through II, 1970 were compared to those based on the single sources. The Comps data were found to be superior if the editing rules were used.

The average price of homes grew faster in the test area than the control area for both the entire period and the 1968-1970 period when an odor problem was in existence. Three explanations were offered for this finding:

(1) The problem was too transitory to be capitalized into property values.

(2) The technique adopted was simply not sensitive enough to detect the small dollar effects likely in this particular study.

(3) Some other factor having an opposite effect than odors may have been present.

Since strong odors were present frequently in the test area beginning in 1969 (this is substantiated in part by the results of the public attitude surveys conducted in TA(Hawthorne)) and since no other factors were found to offset the effects of odors, the most plausible explanation is the insensitivity of the technique.

This study cannot be construed as proving there is no economic effect on home values from odor problems. Although the results of the public attitude surveys (Chapter IV) indicated that odors had not reduced the value of single family residences, subjective evidence was encountered that odors had caused economic losses for at least three industrial concerns. While these losses could not be quantified, they were apparent in terms of increased absenteeism and lower productivity of employees. No other economic effects were found.

NOTES

[1] Robert J. Anderson, Jr., and Thomas D. Crocker, "Air Pollution and Housing: Some Findings." Paper prepared for the Institute for Research in the Behavioral, Economic, and Management Sciences, Herman C. Krannert Graduate School of Industrial Administration, Purdue University, Lafayette, Indiana (January, 1970), p. 2.

[2] Ibid., p. 3.

[3] In the planning stages of this study, Crocker's FHA Chicago study was not known to CIC.

[4] Second bath had stall shower instead of tub.

[5] Apartments and commercial property transfers are published separately.

[6] The tax rate is 55¢ per $500 of value.

[7] It ranged from $22 to $164 for the six month periods affected.

[8] For Holly Glen and Southwest Park, the minimum ratios were 85 percent and 86 percent, respectively. Similarly, the maximums were 123 percent and 122 percent.

[9] $0.856 - 1.000 = -0.144$, $-0.144 \times 2.5 = 0.360$, $1.000 + (-0.360) = 0.640$; $1.226 - 1.000 = 0.226$, $0.226 \times 2.5 = 0.565$, $1.000 + 0.565 = 1.565$.

[10] The highest ratio reflects a sales price 140 percent above the average sales price; then it drops to 132 percent.

[11] For Holly Glen, $R^2 = 0.89$ and for Southwest Park, $R^2 = 0.97$.

[12] Technically, this is of no significance because any difference in the level between two areas should already be capitalized in the home prices. Interest here is thus limited to varying growth rates.

[13] Particularly by the State of California, Department of Public Health, Environmental Epidemiology Unit.

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CHAPTER VII

DEVELOPMENT OF ASSESSMENT PROCEDURES

This chapter focuses on the basis and development of procedures to assess the social and economic impact of odor problems in any community in the United States. The basis for what follows evolved from the findings of the national survey of the odor problem, the present study, and other studies dealing with community odor problems. The development took consideration of odor complaints; the areal extent, frequency, duration, intensity, and temporal proximity of odor perception; the influence of meteorological conditions; and the results of comprehensive field evaluations and public attitude surveys. Three other factors — the needs of local authorities, the ease with which the procedures could be applied, and the costs of undertaking the tasks involved — influenced thought in the development stage.

The initial step was to understand the situations leading to community odor problems. Discussions, particularly with local authorities, revealed two possible situations. They are described here as acute episodes and chronic situations. The following definitions provide a framework for convenient reference rather than a succinct difference in the existence of such situations.[1]

An acute episode is defined as a causation of odors beyond the property limits of a source, occurring no more than once and lasting no more than one day in any three month period. Typically, they arise from accidents or unexpected malfunctions involving industrial processes. Quite often, the odors are of sufficient intensity to motivate many persons to complain, but of insufficient duration to cause more than temporary discomfort or annoyance.

A chronic situation is defined as a causation of odors beyond the property limits of a source, occurring more than once or lasting more than one day in any three month period. Typically, they develop from industrial malpractices, including poor housekeeping, use of faulty equipment, and inadequate process controls in combination with supporting meteorological conditions. Persons tend to complain only when the odors suddenly increase in intensity from levels normally experienced.

This chapter is divided into four sections. The first section deals with the use of odor complaints as a basis for the identification of community odor problems. The second and third sections discuss, respectively, the use of public attitude surveys as the proper basis and sensory techniques as a possible alternative. The final section of this chapter covers possible methods for problem assessment.

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ODOR COMPLAINTS AS A BASIS FOR PROBLEM IDENTIFICATION

Odor complaints, like most community appeals, are almost always initiated by persons who purport to be somehow aggrieved. Solicitation of complaints by local authorities is permitted (but seldom attempted) in some areas and strictly avoided in others, depending upon local policy or interpretation of state law. The vast majority of all grievances are received by telephone and handled by inspectors or clerical personnel. All of the air pollution control agencies visited during the national survey of the odor problem and the present study maintained records of odor complaints on some type of standardized form, examples of which are presented in Figure 14.

When, for example, a complaint is received by the County of Los Angeles, Air Pollution Control District, a summary of the information given by the complainant is recorded on a Radiophone Message Log sheet (Figure 14a) and then dispatched to an inspector in the field. If the complaint involves odors, code 963 is indicated. The inspector is required to drive to the home of the complainant to verify the presence and, if possible, the source of the odors. A Nuisance Complaint Form (Figure 14b) is completed by the inspector at that time, in accordance with the responses of the complainant to the questions on the form.

Use of Complaint Information

Traditionally, odor complaint information has been used for three purposes:

(1) To alert local authorities that odors were detected at specific times and locations.

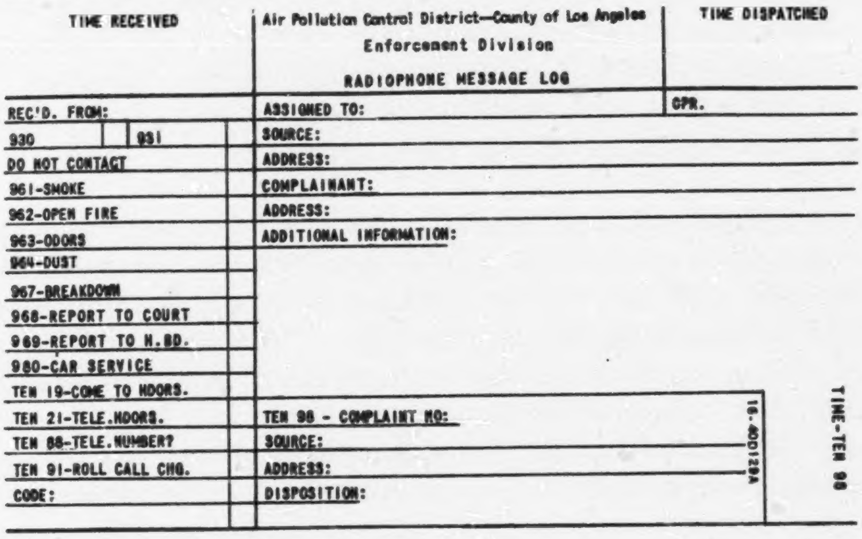
(2) To determine if local law governing the causation of odors has been violated.

(3) To describe the conditions under which odors were detected and to enumerate some of the effects of odors experienced by the persons who complained.

This is, of course, to support possible court action against identified offenders.

It is in the first use that odor complaints are helpful. Clearly, they reduce the amount of surveillance that local authorities might need to maintain over possible odor sources. But, contradictory to traditional practices, they cannot be cited as conclusive evidence or used in the assessment of effects. Consequently, they cannot be applied effectively under the tenets of the appropriate law — public nuisance law.

Figure 14a.



TIME RECEIVED

Air Pollution Control District—County of Los Angeles
Enforcement Division
RADIOPHONE MESSAGE LOG

TIME DISPATCHED

REC'D. FROM:
930 | 931
DO NOT CONTACT
961-SMOKE
962-OPEN FIRE
963-ODORS
964-DUST
967-BREAKDOWN
968-REPORT TO COURT
969-REPORT TO H.BD.
980-CAR SERVICE
TEN 19-COME TO HDQRS.
TEN 21-TELE.HDQRS.
TEN 88-TELE.NUMBER?
TEN 91-ROLL CALL CHG.
CODE:

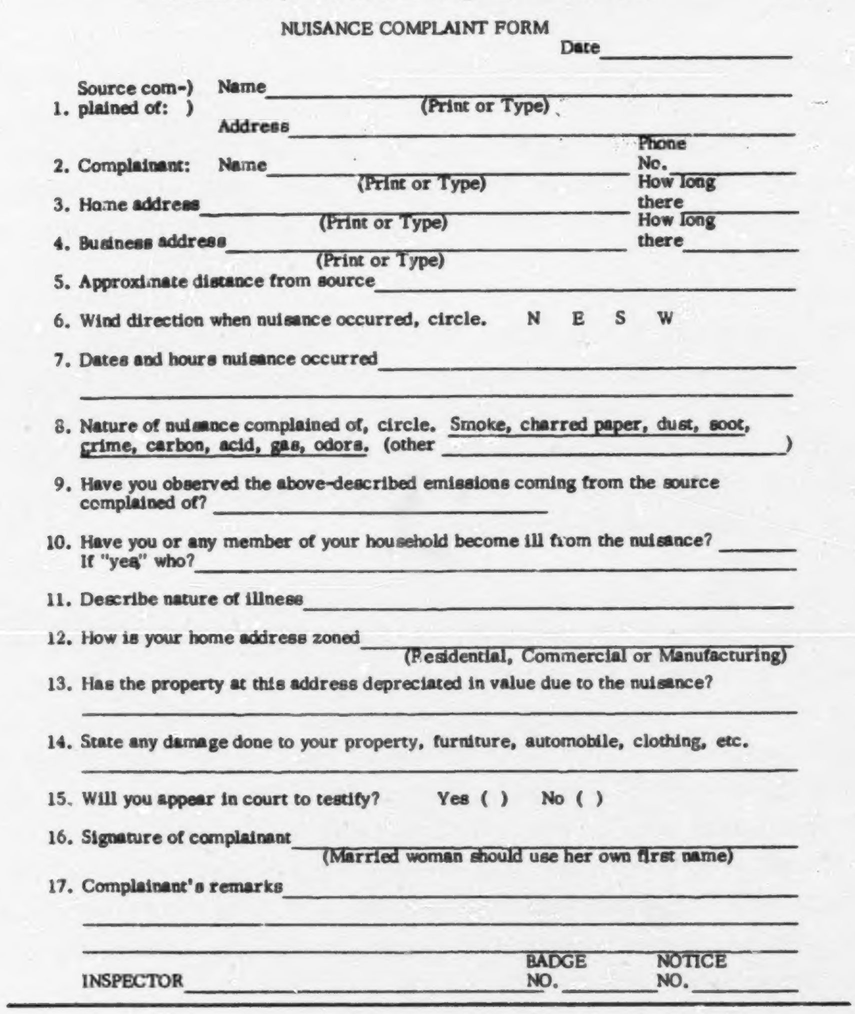
ASSIGNED TO:
OPR.
SOURCE:
ADDRESS:
COMPLAINANT:
ADDRESS:
ADDITIONAL INFORMATION:

TEN 98 - COMPLAINT NO:
SOURCE:
ADDRESS:
DISPOSITION:

16-40D129A

TIME-TEN 98

Figure 14b.



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 South San Pedro Street, Los Angeles, California 90013

40D261
R. 2-69

NUISANCE COMPLAINT FORM

Date__________

1. Source com-) plained of:) Name__________ (Print or Type)
Address__________
2. Complainant: Name__________ (Print or Type) Phone No.______
3. Home address__________ (Print or Type) How long there______
4. Business address__________ (Print or Type) How long there______
5. Approximate distance from source__________
6. Wind direction when nuisance occurred, circle. N E S W
7. Dates and hours nuisance occurred__________
8. Nature of nuisance complained of, circle. Smoke, charred paper, dust, soot, grime, carbon, acid, gas, odors. (other__________)
9. Have you observed the above-described emissions coming from the source complained of?__________
10. Have you or any member of your household become ill from the nuisance?______ If "yes" who?__________
11. Describe nature of illness__________
12. How is your home address zoned__________ (Residential, Commercial or Manufacturing)
13. Has the property at this address depreciated in value due to the nuisance?__________
14. State any damage done to your property, furniture, automobile, clothing, etc.__________
15. Will you appear in court to testify? Yes ( ) No ( )
16. Signature of complainant__________ (Married woman should use her own first name)
17. Complainant's remarks__________

INSPECTOR__________ BADGE NO.______ NOTICE NO.______

The difficulty with using odor complaints, other than as indicators of where odor problems may exist, lies in the probability that the complainants do not represent the normal person in the community. Consumer and social research studies have found repeatedly that the likes and dislikes of persons who volunteer their opinions are different from the likes and dislikes of their neighbors who must be solicited for their opinions.

Of similar importance, studies have found that persons who volunteer their opinions tend to exaggerate. Thus, persons who volunteer complaints about a particular situation may be expected to overstate their concern. An example of this recently occurred in Sweden. Twelve hundred persons signed a petition demanding that authorities eliminate the nuisance of offensive flue gases caused by a sulfate cellulose factory. In response to a later survey sponsored by local public health authorities, almost half of these persons stated they had not experienced annoyance during the period specified in the petition. The contradiction of statements could not be explained by diminished exposure since the time the petition was submitted. The petition was rejected as a reliable measure of the extent of concern.

Need for an Effective Standard

In the application of public nuisance law, substantial and unreasonable interference to the normal person in the community must be found. When the presence of odors affects property values, as may happen in extreme chronic situations, such interference is seldom in doubt. But, when odors involve mere personal discomfort or annoyance, substantial and unreasonable interference is difficult to find.[2]

What is needed is a standard against which community odor problems can be properly identified and assessed. For the reasons just presented, such a standard must consider the attitudes of a cross-section of members of odor affected communities. From a recent survey, it is estimated that, at present, only 5 percent of all state and local air quality agencies utilize such considerations in their attacks on odor problems.[3]

The development and evaluation of a model odor control standard is the objective of a third phase of research to be conducted by Copley International Corporation for the Environmental Protection Agency during 1972. Since the tentative content of such a standard was evident from the results of the first and second phases of the work, a set of procedures was developed for use with the ordinance and is provided in a manual attached to this report. It is felt that the instructions are not applicable to acute episodes (defined above), but rather to the more difficult to control chronic situations. Acute episodes involving emissions of measurable concentrations of odorous substances into the atmosphere can be dealt with as possible infractions of air quality standards governing such substances, not as odor problems.

For a fuller understanding of the subsequent material in this chapter, the reader may wish to review "Procedures for the Identification and Assessment of Community Odor Problems." The following sections of this chapter critique the contents of the manual and discuss possible extensions.

PROPER BASIS FOR PROBLEM IDENTIFICATION

The identification of odor problems is requisite to determining if state or local law has been violated. Indeed, identification should constitute violation. The basis for decision rests not solely with the feelings of the population in an odor affected (test) area, but in a comparison of their attitudes with the attitudes of a population in an odor free (control) area. Such a comparison serves two purposes:

(1) Under the assumption that both populations have equal right to odor free air, it provides an equitable basis for decision.

(2) Since what the population in the test area says about odors may not reflect what it actually feels about odors, it permits an estimation of true attitudes.

Thus, the procedure for problem identification involves the use of public attitude surveys and a means for comparing the results.

The most difficult task in conducting public attitude surveys is the delineation of test and control areas. The procedure specifies the necessary steps. Efficiency in undertaking this task evolves with experience. Assistance could be obtained from property appraisers on the staffs of governmental agencies or those in private practice.

The recommended public attitude survey was designed to obtain decisive results as rapidly as possible. The instructions were written in such a way as to clarify the necessary tasks as much as possible. For example, since it was expected that clerical personnel would conduct the interviews, the interviewer instructions are especially detailed.

The recommended sample sizes were predicated on an expected minimum interview completion rate of 33 percent. They are large enough to permit a representative cross-section of a population to be analyzed without the need to employ small sample statistics.

The questionnaire was intended to be as brief as possible. Thirteen questions were developed from the present study to achieve the following purposes:

Question 1. Screening question related to the effective period of a street address (reverse order) telephone directory.

Question 2. Introductory question aimed at whether there is concern about various types of pollution in the respondent's neighborhood. This is to establish the general context of the questionnaire in the respondent's mind.

Question 3. Same as question 2.

Question 4. Introduction to questions directed at the respondent's attitude toward odors in his neighborhood.

Question 5. Question leading to the determination of an odor problem index number for the area being studied.

Question 6. Same as question 5.

Question 7. Same as question 5.

Question 8. Same as question 5.

Question 9. Question leading to a decision as to whether an odor problem exists in the area being studied.

Question 10. Same as question 5.

Question 11. Question to assist state or local authorities in identifying source(s) of odors affecting the area being studied.

Question 12. Screening question to indicate possible bias in responses due to respondent's association with the source(s) of odors.

Question 13. Same as question 12.

Each of the questions was carefully worded and tested to ensure understanding by both interviewers and respondents. Testing indicated that all of the questions could be administered to a respondent by an experienced interviewer in a maximum of three minutes.

Unlike most complaint forms used by air quality agencies (cf. Figure 14b), the questionnaire does not solicit the exact time odor was last detected by the residents of the test area or the direction of the wind at that time. These data may assist local authorities in verifying the source and still can be collected when complaints are received. But, since the questionnaire is meant to test chronic situations which, by definition, exist over time, it would not be appropriate for the questionnaire to be used to solicit such data. Instead, recognition of the source is solicited directly. When odors are experienced in a community frequently or over long duration, it is common for the residents to know or at least suspect the source.

Use of Survey Results

Upon completion of public attitude surveys in matched test and control areas, all questions may be tabulated. But, for odor problem identification, tabulation should begin with question 9, "Would you say these odors have bothered you?"

Odor problem identification depends on the outcome of applying "z" statistics. A 95 percent level of confidence ($z \geq 1.65$) that more test area respondents than control area respondents are bothered by odors is required before an odor problem can be said to exist. Such confidence seemed optimal from the application of "z" statistics to the results of the present study (Table 17). It was found, for example, that odor problems existed in TB(Torrance) in December 1970 ($z = 5.33$) and March 1971 ($z = 2.96$) and TA(Hawthorne) in June 1971 ($z = 5.39$).[4] Consistent with these findings, public concern in these communities about recent episodes of strong oil refinery odors was high in these respective months.

If more than one odor problem is identified within the jurisdiction of the concerned state or local agency, abatement priorities can be established by calculating an index number for each problem. An odor problem index number increases with the frequency, duration, intensity, or temporal proximity of odors and the amount of annoyance they cause. The information flow leading to both odor problem identification and index determination is diagramed in Figure 15.

Another use of survey results is that of estimating true attitudes. The method for doing so is discussed in Chapter III. The survey results indicated that in December, 81 percent of the respondents in TB(Torrance) and 37 percent of the respondents in CB(Torrance) claimed to have noticed odors in their neighborhoods in the last three months and been bothered by them. By applying the correction formula to these results, it was estimated that only 70 percent of the respondents in TB(Torrance) actually noticed and were bothered by odors. Quite similarly, in June, 75 percent of the respondents in TA(Hawthorne) and 31 percent of the respondents in CA(Torrance) made such claims. By applying the correction formula, it was concluded that only 64 percent of the respondents in TA(Hawthorne) actually noticed and were bothered by odors.

These estimates of true attitudes in the two identified problem areas are not dramatic revelations of hidden truths. The estimates are not much different from the uncorrected results. However, a dramatic impact can be seen by examining the results of non-problem areas. For example, in June, 32 percent of the respondents in TA(El Segundo) and 27 percent of the respondents in CA(South Torrance) claimed to have noticed odors in their neighborhoods in the

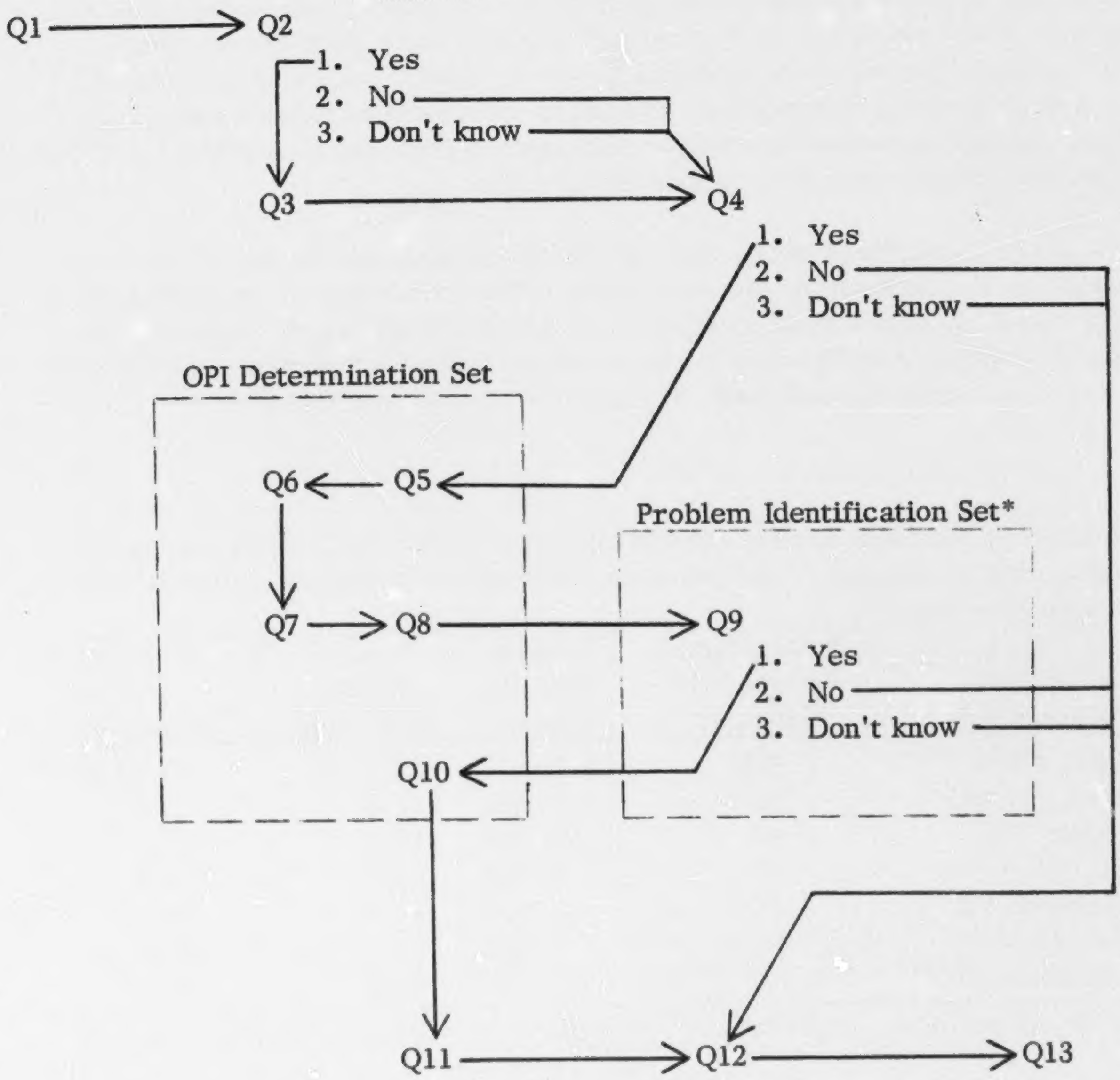
Table 17. Application of "z" statistics to the results of the public attitude surveys.

Test Area/Control Area Compared	No. of Interviews Completed in Test Area	No. of Interviews Completed in Control Area	No. of Respondents in Test Area Who Noticed and Were Bothered	No. of Respondents in Control Area Who Noticed and Were Bothered	Value of Normal Deviate (z)
December 1970					
TA(Hawthorne)/CA(Torrance)	68	50	44 (65%)	27 (54%)	1.17
TA(X Hawthorne)/CA(X Torrance)	82	101	47 (57%)	48 (48%)	1.32
TB(Torrance)/CB(Torrance)	54	110	44 (81%)	41 (37%)	5.33*
TB(X Torrance)/CB(Torrance)	51	110	26 (51%)	41 (37%)	1.64
TB(Glendale)/CB(Glendale)	51	51	5 (10%)	11 (22%)	--
March 1971					
TA(Hawthorne)/CA(Torrance)	75	50	46 (65%)	26 (52%)	1.03
TA(El Segundo)/CA(South Torrance)	75	50	30 (40%)	15 (30%)	1.14
TB(Torrance)/CB(Torrance)	75	75	51 (68%)	33 (44%)	2.96*
TB(Beverly Hills)/CB(Beverly Hills)	50	50	2 (4%)	7 (14%)	--
June 1971					
TA(Hawthorne)/CA(Torrance)	75	75	56 (75%)	23 (31%)	5.39*
TA(El Segundo)/CA(South Torrance)	75	75	24 (32%)	20 (27%)	0.72

"X" before name of community indicates area studied in December 1970 was replaced by alternate area in March 1971. TB(X Torrance) was eliminated from further consideration.

*Indicates odor problem in test area ($z \geq 1.65$).

Figure 15. Method of odor problem identification and index determination using the Problem Identification Questionnaire.


Q1
Q2
1. Yes
2. No
3. Don't know
Q3
Q4
1. Yes
2. No
3. Don't know
OPI Determination Set
Q6
Q5
Q7
Q8
Problem Identification Set*
Q9
1. Yes
2. No
3. Don't know
Q10
Q11
Q12
Q13

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* Based on test and control areas being significantly different at the 95 percent level (one-tail test).

last three months and to have been bothered by them. Use of the correction formula indicated that only 7 percent of TA(El Segundo) respondents expressed their true feelings.

Elimination of Surveys in Control Areas

To simplify the requirements for odor problem identification, consideration was given to the elimination of surveys in control areas. It was hoped that a percentage could be established to account for the proportion of residents in all control areas who could be expected to say they were bothered by odors. The grounds for pursuing this possibility was the assumption that all control areas are sufficiently common with regard to the absence of odors and, consequently, that a representative sample of residents from all such areas could be expected to express the same attitude about odors.

Table 18 provides data collected during the national survey of the odor problem that is pertinent to this possibility. The percentage of respondents who were bothered by odors in the control areas varied widely from 18 percent in Tampa to 45 percent in Portland. These extremes are significantly different at the 1 percent level (two-tail test) and cannot be considered from the same population.

Table 18. Percentage of respondents who were bothered by odors and socioeconomic characteristics of control areas determined during the national survey of the odor problem.*

Location of Control Area	Percentage of Respondents Bothered	Median Family Income	Median Education	Median Age of Respondent
Portland, OR	45%	$ 5,900	12.5 yrs.	59.4 yrs.
Kansas City, MO	32	7,300	11.8	51.3
Cincinnati, OH	25	12,600	13.2	46.1
Buffalo, NY	42	6,600	11.0	53.7
Philadelphia, PA	41	9,300	12.6	48.6
Tampa, FL	18	9,300	12.6	48.8
San Francisco, CA	34	5,500	11.5	52.2

*Data developed from interviews of from 160 to 180 residents in each control area.

A similar possibility of establishing a series of percentages, each to represent the proportion of residents in control areas of given socioeconomic characteristics was also rejected. Although the socioeconomic backgrounds of the Tampa and Philadelphia control areas were virtually ideal, the percentage of respondents who were bothered by odors was also significantly different at the 1 percent level (two-tail test).

Many factors could account for these differences, the most likely of which are:

(1) Differences in odor producing potential, i.e., differences in the number and types of odor producing industrial facilities and the number of motor vehicles in operation.

(2) Differences in atmospheric dilution capacity.

(3) Possible regional differences in attitudes about odors.

The results of the present study suggested difficulties with establishing a series of percentages at the local level. The data presented in Table 19 indicate that respondents in control areas located in the same quarter of Los Angeles may not be of the same population. For example, avoiding seasonal variations, the percentage of respondents who noticed and were bothered by odors in December 1970 varied from 37 percent to 54 percent in Torrance. Again, in March 1971, the percentage of respondents who noticed and were bothered by odors varied from 30 percent to 52 percent in Torrance. These extremes are significantly different at the 5 percent level (two-tail test).

Table 19. Percentage of respondents who noticed and were bothered by odors and socioeconomic characteristics of control areas determined during the present study.*

Control Area	Percentage of Residents Noticed and Bothered	Median Family Income	Median Education	Median Age of Respondent
December 1970				
CA(Torrance)	54%	$12,200	12.8 yrs.	36.5 yrs.
CA(X Torrance)	47	12,800	14.2	35.4
CB(Torrance)	37	11,500	13.0	41.2
CB(Glendale)	22	7,800	12.7	53.0
March 1971				
CA(Torrance)	52	12,500	13.1	37.4
CA(South Torrance)	30	13,600	15.3	41.0
CB(Torrance)	44	12,300	12.9	41.2
CB(Beverly Hills)	14	15,000+	16.0	53.6
June 1971				
CA(Torrance)	30	13,600	12.9	42.5
CA(South Torrance)	26	13,900	14.5	40.1

*Data developed from interviews of from 50 to 110 residents in each control area.

The data also indicate that it would be an almost impossible task to predict the proportion of residents in a given control area from knowledge of the socioeconomic characteristics of that area. Note that CB(Glendale) and CB(Beverly Hills) were the lowest and highest family income control areas investigated in the Los Angeles metropolitan area. Yet, both contained relatively fewer respondents who noticed and were bothered by odors than any of the intermediate family income control areas. The same pattern held for education, and no consistent relationship could be established for age.

It must be recalled, however, that CA(Torrance) was established not because it represented the most odor free community having socioeconomic characteristics similar to TA(Hawthorne), but because it was relatively odor free and satisfied the "other things equal" criterion of being nearby a major oil refinery. This was necessary for the property value analysis described in Chapter VI. Of all the Torrance control areas, only CA(South Torrance) could be considered as odor free as possible. Appropriate rules for use in future studies would be to establish a control area at least two miles from a major odor source and to avoid downwind locations entirely (as was the case for CA(Torrance) to some extent in December and March).

The best possibility of eliminating surveys in control areas was found by combining the results from CA(South Torrance) with the results from the questionnaire test area (located two miles south of CA(South Torrance)). The combination of data produced an average of 14.8 respondents who noticed and were bothered by odors out of an average of 56.3 interviews completed, which is 26.3 percent. This possibility, to be tested again by Copley International Corporation during the third phase of research, would require a combination of the results of about three public attitude surveys in communities having similar socioeconomic characteristics, which are as odor free as possible.

Reduction of Effort in Test Areas

If surveys in control areas can be eliminated by the possibility just discussed, the averages established could be used to reduce the effort required to survey test areas. This reduction of survey effort seems possible through sequential analysis.

The fundamental difference between sequential analysis and a conventional survey technique is that the number of interviews completed using sequential analysis is dependent upon the number of answers to key questions. After each interview is completed, the results obtained are added to those already obtained during the survey and compared with a pair of statistics previously computed. On the basis of this comparison, one of three decisions can be made:

(1) That an odor problem is identified.

(2) That an odor problem does not exist.

(3) That the results are inconclusive and that an additional interview must be completed.

Before interviewing is begun, two sets of critical values are computed. One set of these values indicates, for each sample size, the minimum number of respondents who must claim to have noticed and been bothered by odors before it can be decided that the community being surveyed has an odor problem. Such values are, therefore, "odor problem decision numbers." The other set of values indicates, for each sample size, the maximum number of respondents who can claim to have noticed and been bothered by odors before it can be decided that the community surveyed does not have an odor problem. These values are "no odor problem decision numbers."

In the southern quarter of the Los Angeles metropolitan area, it was found that 26.3 percent of the respondents in a combination of control areas said they noticed and were bothered by odors. At least 41.0 percent of respondents in a test area would have to claim such an effect before an odor problem could be identified in that area, i.e., before $z = 1.65$. Since the control areas were as odor free as possible, the decimal equivalent of 26.3 percent may equitably be called the "acceptable odor level (AOL)." The decimal equivalent of 41.0 percent may be called the "odor problem level (OPL)." Given an AOL and OPL, a sequential sampling plan could be designed that is as decisive, but generally less costly than the conventional survey technique recommended in the attached procedure manual. Such a plan would be based on the relationships:

$$c = -h_1 + sN$$
$$c = h_2 + sN$$

where:

$$h_1 = \log \frac{1-\alpha}{\beta} / \log \frac{OPL\ (1-AOL)}{AOL\ (1-OPL)}$$

$$h_2 = \log \frac{1-\beta}{\alpha} / \log \frac{OPL\ (1-AOL)}{AOL\ (1-OPL)}$$

$$s = \log \frac{1-AOL}{1-OPL} / \log \frac{OPL\ (1-AOL)}{AOL\ (1-OPL)}$$

and where: c = an odor problem decision number (when considered in relation to h_2) or a no odor problem decision number (when considered in relation to h_1). In general, c represents the number of respondents in the community being surveyed who say they have noticed and been bothered by odors

α = the probability that an odor problem decision will be reached when no odor problem exists

β = the probability that a no odor problem decision will be reached when an odor problem exists

AOL = an acceptable odor level

OPL = an odor problem level

N = sample size

Sequential analysis was tried on the questionnaires completed in the June public attitude surveys of TA(Hawthorne) and CA(Torrance). This was possible several weeks after the surveys had been conducted, since the dates and times of the interviews were marked on the questionnaires. By employing the above relationships, the sequential sampling plan given in Table 20 was prepared. By referring to the plan, it was decided that an odor problem existed in TA(Hawthorne) after reviewing only seven questionnaires in chronological order (Figure 16a). It was further decided that, as had been anticipated, no odor problem existed in CA(Torrance) after reviewing only 41 questionnaires in the order in which they were completed (Figure 16b). This would have permitted a reduction of 68 interviews in TA(H) had sequential analysis been employed during the survey. Such a reduction would have been possible because of the extent of the problem in TA(H). It is estimated that such a decision would not have been reached quite so readily or at all during surveys of the other test areas. Attempts at applying this technique will be continued in the third phase of research.

POSSIBLE ALTERNATIVE BASIS FOR PROBLEM IDENTIFICATION

It may be possible to use sensory techniques to identify community odor problems, but if public nuisance law is to be applied to odor cases, sensory techniques must be shown to be reliable predictors of public attitudes about odors. It was planned to correlate the data obtained from the use of scentometers and odor judgment panels with the information collected during the public attitude surveys to establish dose/response relationships. Unfortunately, too little was discovered, particularly in terms of day-to-day differences, to be conclusive.

Table 20. Sequential sampling plan for deciding whether or not an odor problem exists in a community being surveyed. (AOL = 0.263, OPL = 0.410, $\alpha = 0.05$, $\beta = 0.05$)

Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.	Sample Size	No Odor Problem Decision No.	Odor Problem Decision No.
1	*	*	26	4	14
2	*	*	27	4	14
3	*	*	28	4	14
4	*	*	29	5	15
5	*	*	30	5	15
6	*	*	31	5	15
7	*	7	32	6	16
8	*	8	33	6	16
9	*	8	34	6	16
10	*	8	35	7	17
11	*	9	36	7	17
12	*	9	37	7	17
13	*	9	38	8	18
14	*	10	39	8	18
15	*	10	40	8	18
16	*	10	41	9	19
17	1	11	42	9	19
18	1	11	43	9	19
19	1	11	44	10	20
20	2	12	45	10	20
21	2	12	46	10	20
22	2	12	47	11	21
23	3	13	48	11	21
24	3	13	49	11	21
25	3	13	50	12	22

* A no odor problem decision cannot be reached until 17 interviews have been completed; an odor problem decision cannot be reached until 7 interviews have been completed.

The principal difficulty was with the intensities of odors encountered. All three studies took place during what may be characterized as moderately chronic situations. Although odors were perceived on most days in Test Area A, they were of only slight to moderate intensity. In all probability, episodes of strong odors on the first or second day of each survey would have produced more satisfying results.

In terms of quarterly survey averages, the percentage of respondents in TA(Hawthorne) who answered affirmatively to "Would you say that these odors have bothered you?" did not vary well with the mean odor intensities recorded by the odor judgment panel. A closer relationship was found between the per-

Figure 16a. Sequential sampling chart indicating an odor problem in TA (Hawthorne) during the June 1971 public attitude survey.

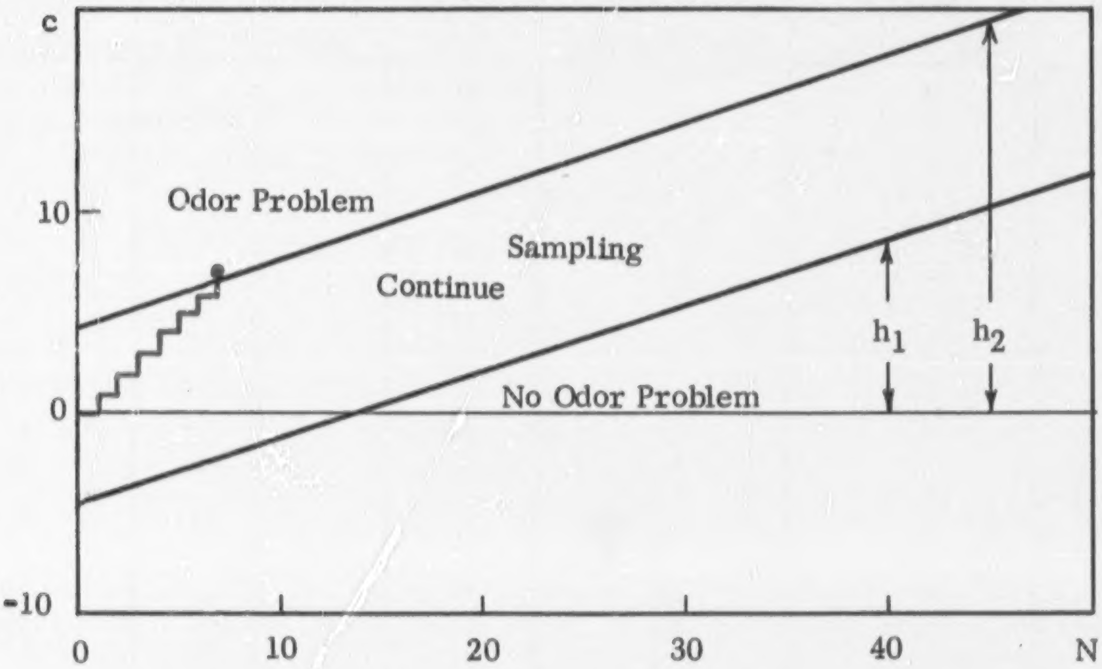
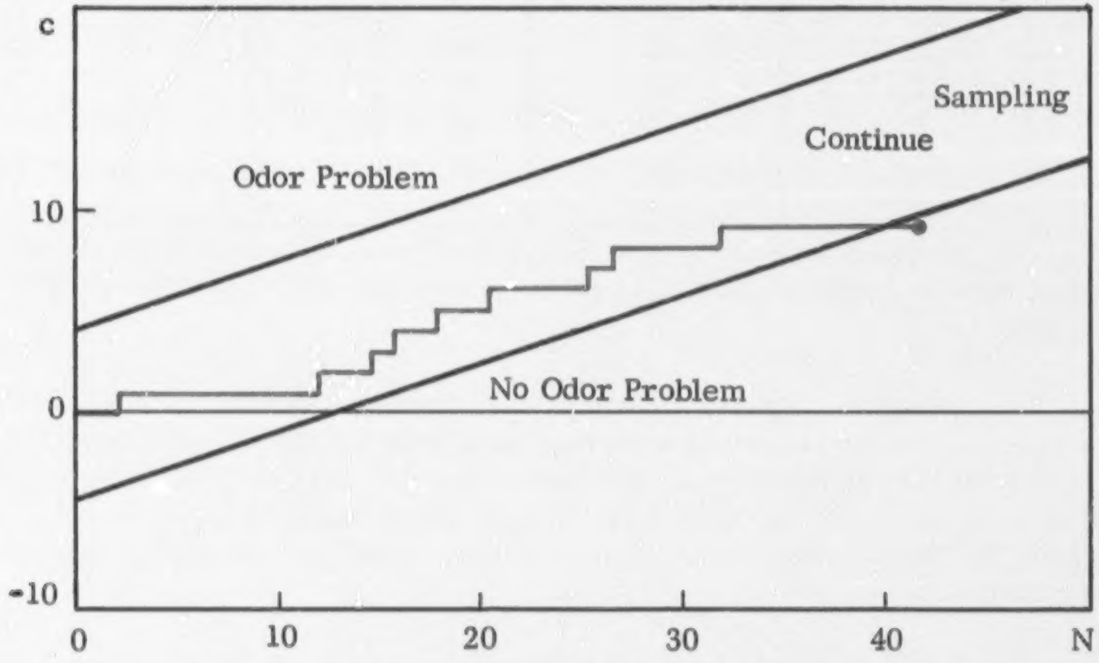


Figure 16b. Sequential sampling chart indicating no odor problem in CA (Torrance) during the June 1971 public attitude survey.



centage of respondents who answered affirmatively to "Have you noticed any odors in your neighborhood in the last three months?" and the percentage of time odor was detected by the panelists. These results suggest two possible conclusions:

(1) The longer the time odors can be detected in a community, the greater the number of residents who will notice them.

(2) The mean intensity of odors detected in a community is not a good indicator of annoyance to the residents.

Unless odor intensities can be somehow related to an index of problem perception, the use of sensory techniques may be limited to estimating the percentage of residents in a community who notice odors. Even so, there may be an indirect relationship to annoyance. Table 21 shows the percentages of respondents in test areas affected by oil refineries who were bothered by odors that they noticed. Although chi-square analyses indicated that the differences between areas were significant at the 1 percent level, differences within a particular area between quarters were not significant. This could mean that, for a particular test area affected by a particular source, the number of residents who are bothered by the odors caused by that source may be a constant percentage of those who notice the odors. Since sensory techniques probably could be used to predict the percentage of residents who notice odors, under these very restrictive conditions they could be used to predict the existence of an odor problem as well. Copley International Corporation will give further consideration to this possible alternative for problem identification in the next phase of research.

POSSIBLE METHODS FOR PROBLEM ASSESSMENT

It was planned that the national survey of the odor problem and the study of the social and economic impact of odors would provide a series of relationships that could be used in the development of federal air quality, performance, and emission standards. Yet, as this and other research progressed, it became evident that the measurable reaction to a vast majority of odor problems was annoyance, not other social or economic effects. Thus, a general means for dealing with such problems must consider personal evaluations as central to success. Still, extremely chronic situations may be encountered where, beyond annoyance, other effects also should be measured so that totally equitable solutions can be reached.

An extremely chronic situation was not encountered in any of the communities investigated during the national survey or the present study. It is felt, however, that such a situation may be assumed to exist if more than 50 percent

Table 21. Percentage of respondents in test areas affected by the odorous emissions of oil refineries who were bothered by odors that they noticed.

Test Area	No. of Respondents Who Noticed Odors	No. of Respondents Who Were Bothered By Odors That They Noticed	Percentage of Respondents Who Were Bothered By Odors That They Noticed
December 1970			
TA(Hawthorne)	48	44	92%
TB(X Hawthorne)	51	47	92
TB(Torrance)	45	44	98
March 1971			
TA(Hawthorne)	59	46	78
TA(El Segundo)	44	30	68
TB(Torrance)	66	51	77
June 1971			
TA(Hawthorne)	59	56	95
TA(El Segundo)	42	24	57

of test area residents interviewed state they have been bothered "Very much" by odors in their community.

Because of a deficiency of recorded information in most localities, determination of the types of effects to be measured is best approached with an extended public attitude survey. A questionnaire which would fill this need appears in Appendix E. The form is an extension of the problem identification questionnaire.. Questions 1 through 10 and 22 through 24 reproduce the questionnaire entirely. Thus, the effects determination questionnaire could serve two purposes, viz., to broaden the data base for odor problem identification and to determine how residents feel odors have affected themselves, their families, and their properties.

Methods of measuring effects are available. Social effects are measured to some extent by the questionnaire itself. Forced changes in family living patterns may be found from responses to questions 11 through 14. Although revelation of health effects is solicited in questions 15 through 18, verification and measurement of the extent of such effects would entail contacts with respondents' physicians. The principal economic effect of odors can be measured especially in terms of residential property value differentials. The possibility that such an effect exists is solicited in questions 19 through 21. A description of the data required and analysis employed in this aspect of problem assessment is presented in Chapter VI.

SUMMARY

The initial step in the development of assessment procedures was to understand the situations leading to community odor problems. Two possible situations — acute episodes and chronic situations — were defined, but only the latter may lead to an odor problem.

The difficulty with using odor complaints as conclusive evidence of the existence of odor problems or in the assessment of effects was discussed. It lies in the probability that the complainants do not represent the normal person in the community. Thus, complaints cannot be applied effectively under the tenets of the appropriate law — public nuisance law.

In the application of public nuisance law, substantial and unreasonable interference to the normal person in the community must be found. The identification of community odor problems is requisite to determining if state or local law has been violated. The basis for decision rests not solely with the feelings of the population of an odor affected (test) area, but in a comparison of their attitudes with the attitudes of a population in an odor free (control) area. Public attitude surveys were recommended and employed in the identification of community odor problems.

To simplify the requirements for odor problem identification, consideration was given to the elimination of surveys in control areas. The best possibility of doing so was found by combining the results from the odor free control areas investigated in the southern quarter of the Los Angeles metropolitan area. The results of surveys conducted in Los Angeles test areas of similar socioeconomic background could be compared to the combined results. It is felt that such comparisons could be made for at least one year before additional control area surveys would have to be conducted.

The same combined results could be used to reduce the effort required to survey test areas. This reduction of survey effort seems possible through sequential analysis under which one of three decisions can be made:

(1) That an odor problem is identified.

(2) That an odor problem does not exist.

(3) That the results are inconclusive and that an additional interview must be completed.

Sequential analysis was tried on the questionnaires completed in the June public attitude surveys of TA(Hawthorne) and CA(Torrance). Using this method, it was found that an odor problem existed in TA(Hawthorne) after reviewing only seven questionnaires in chronological order and that no odor problem existed in CA(Torrance) after reviewing only 41 questionnaires in the same way.

It was planned to correlate the data obtained from the use of scentometers and odor judgment panels with the information collected during the public attitude surveys. Unfortunately, no conclusive dose/response relationships were discovered.

A possible method for problem assessment was discussed. It would involve an extension of the problem identification questionnaire recommended in the attached procedure manual and, consequently, could be used to broaden the data base for odor problem identification and to determine how residents feel odors have affected themselves, their families, and their properties.

NOTES

[1] A "chronic situation" is meant to include not only prolonged or frequent causation of odors, but also more than one acute episode in any three month period. The three month period was stipulated on the assumption that most persons would be unable to recall details of previous episodes after such time.

[2] William L. Prosser, Law of Torts (3rd ed.; St. Paul, Minnesota: West Publishing Company, 1964), 599 and 602.

[3] It could not be determined from the survey how the few agencies that considered public opinion selected samples of residents to be interviewed.

[4] If TA(Hawthorne) had been compared to CA(X Torrance) in December and CA(South Torrance) in March, it would have been decided an odor problem existed in the test area at both times (z equalled 2.20 and 3.43, respectively).

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APPENDICES

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APPENDIX A

FIELD PROGRAM PREPARATION DATA

Map of test and control areas studied in Los Angeles metropolitan area.

Topographical features of TA(Hawthorne) and TA(El Segundo).

Local climatological data sheets of Los Angeles, California, International Airport for December 1970, March 1971, and June, 1971.

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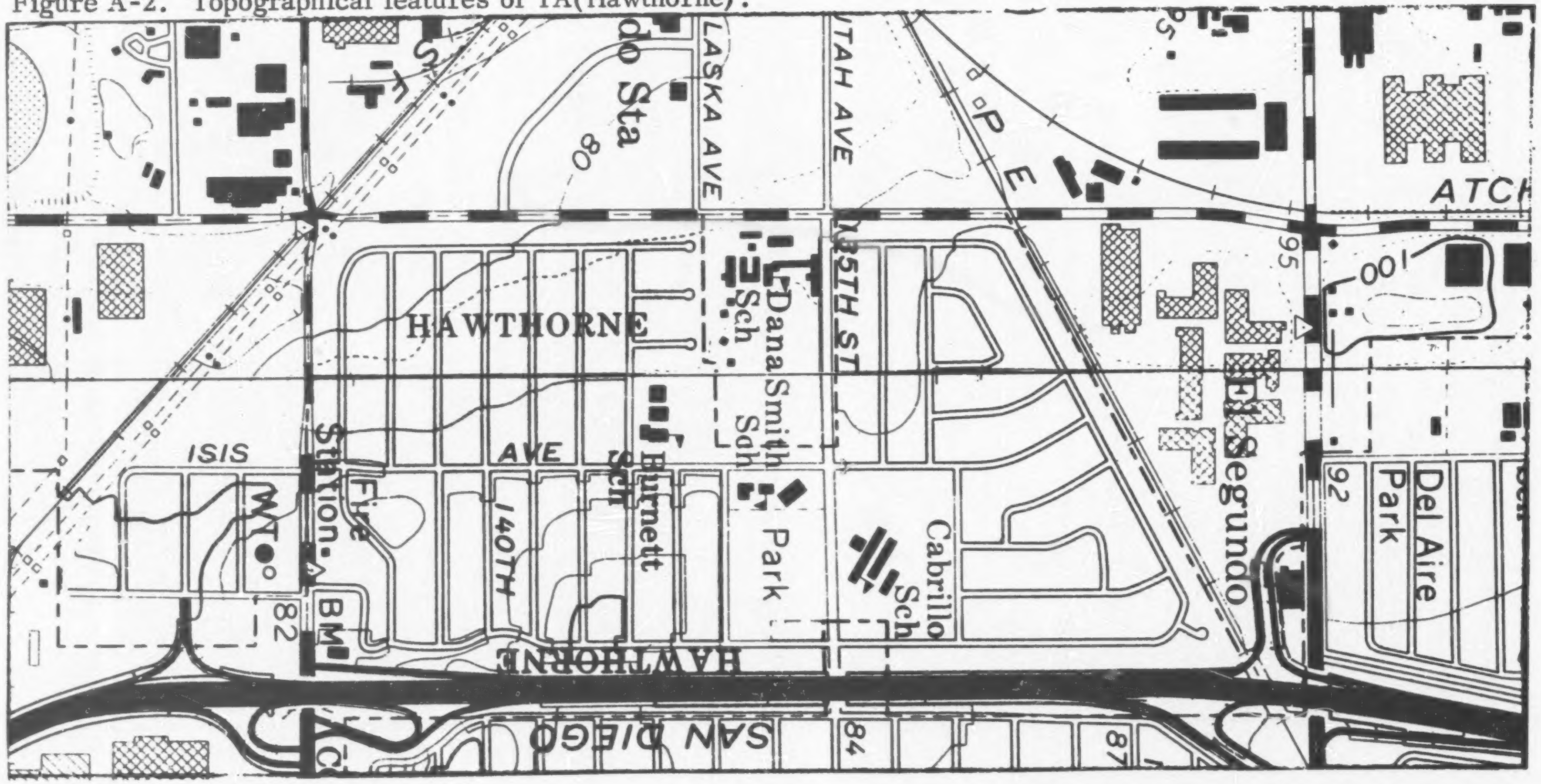
Contour lines are at 10 foot intervals.

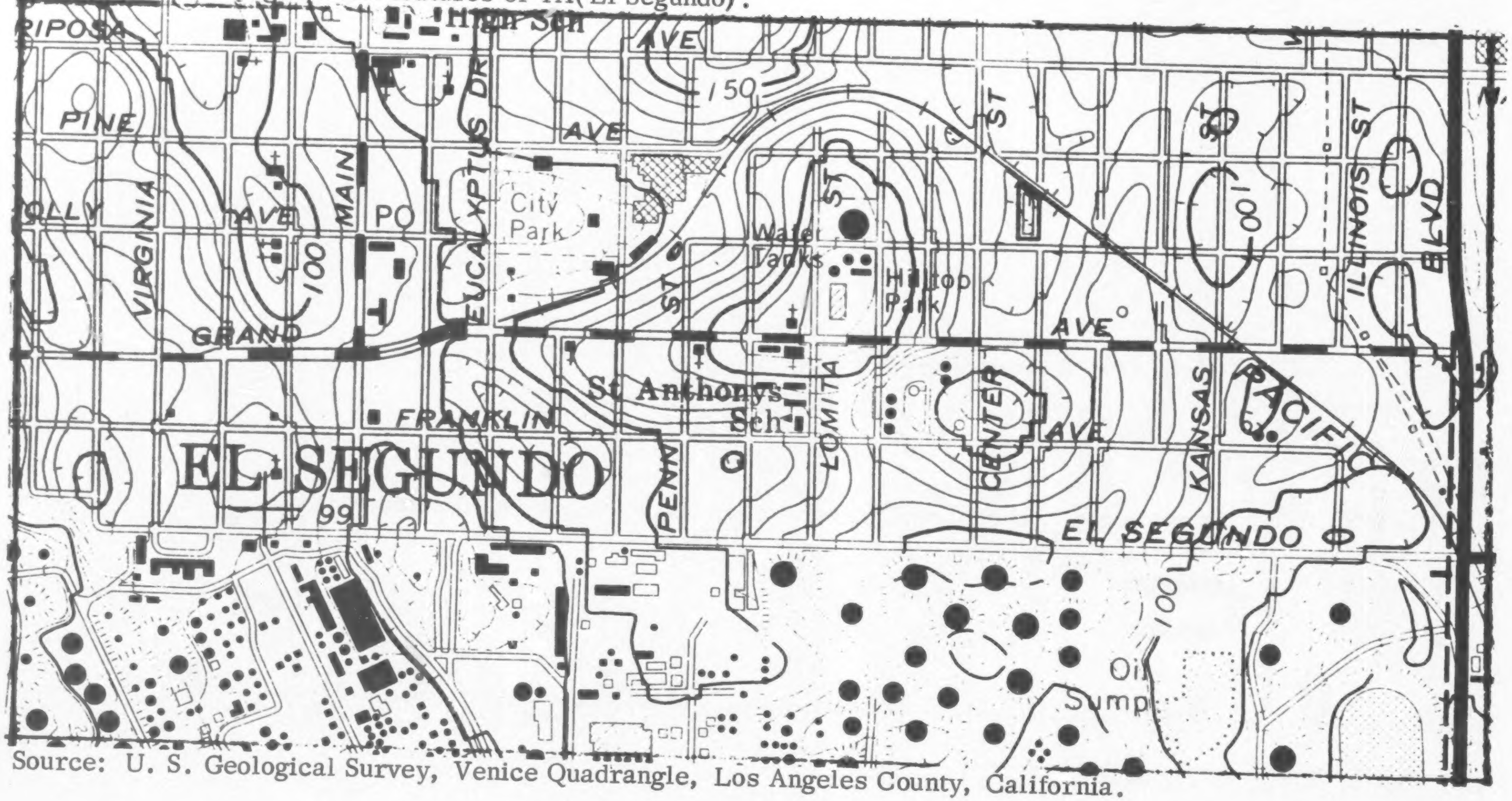
Figure A-2. Topographical features of TA(Hawthorne).


ATCH
El Segundo
Del Aire
Park
92
95
100
P E
UTAH AVE
135TH ST
LASKA AVE
do Sta
80
Dana
Sch
Smith
Sch
Cabrillo
Sch
Park
Burnett
Sch
HAWTHORNE
AVE
140TH
ISIS
Fire
Station
WT
BM
82
84
87
HAWTHORNE
SAN DIEGO

Source: U.S. Geological Survey, Venice and Inglewood Quadrangles, Los Angeles County, California

Contour lines are at 10 foot intervals.

Figure A-3. Topographical features of TA(El Segundo).


RIPOSA
High Sch
AVE
150
PINE
AVE
ST
ST
ST
ILLINOIS ST
BLVD
OLLY
VIRGINIA
AVE
MAIN
PO
EUCALYPTUS DR
City Park
Water Tanks
Hilltop Park
100
100
GRAND
AVE
St Anthonys Sch
FRANKLIN
LOMITA
CENTER
AVE
KANSAS
PACIFIC
EL SEGUNDO
99
PENN
EL SEGUNDO
100
Oil Sump

Source: U. S. Geological Survey, Venice Quadrangle, Los Angeles County, California.

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

LOCAL CLIMATOLOGICAL DATA
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

LOS ANGELES, CALIFORNIA
INTERNATIONAL AIRPORT
DECEMBER 1970

Latitude 33° 56′ N Longitude 118° 24′ W Elevation (ground) 97 ft. Standard time used: PACIFIC WBAN #23174

Date 1	Temperature °F Maximum 2	Minimum 3	Average 4	Departure from normal 5	Average dew point 6	Degree days Base 65° Heating 7A	Cooling 7B	Weather types on dates of occurrence (1 Fog, 2 Heavy fog x, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow) 8	Snow, ice pellets or ice on ground at 04AM In. 9	Precipitation Water equivalent In. 10	Snow, ice pellets In. 11	Avg. station pressure In. Elev. 104 feet m.s.l. 12	Wind Resultant direction 13	Resultant speed m.p.h. 14	Average speed m.p.h. 15	Fastest mile Speed m.p.h. 16	Direction 17	Sunshine Hours and tenths 18	Percent of possible 19	Sky cover Tenths Sunrise to sunset 20	Midnight to midnight 21	Date 22
1	62	51	57	-2	49	8	0	8	0	0	0	30.03	25	2.3	6.3	13	W/			6	7	1
2	62	53	58	-1	49	7	0	1	0	.21	0	30.05	26	5.6	10.6	35	W/			7	6	2
3	62	48	55	-4	44	10	0		0	0	0	30.14	29	1.7	7.2	14	W/			2	2	3
4	69	49	59	1	47	6	0	8	0	0	0	30.06	17	2.1	5.8	12	W/			2	2	4
5	77	53	65	7	44	0	0	8	0	0	0	30.02	32	2.2	6.3	13	W/			3	2	5
6	77*	56	67*	9	44	0	2		0	0	0	29.96	33	1.8	7.1	13	W/			9	6	6
7	72	55	64	6	46	1	0		0	0	0	29.89	32	.1	6.0	15	W/			4	4	7
8	58	52	55	-3	53	10	0	2 8	0	T	0	29.90	14	2.3	5.9	12	E/			10	9	8
9	62	54	58	0	50	7	0	1 8	0	.45	0	29.92	28	4.2	9.5	25	W/			4	4	9
10	69	49	59	1	44	6	0		0	0	0	30.02	02	1.9	6.6	14	W/			0	0	10
11	73	49	61	3	31	4	0	8	0	0	0	29.91	01	5.8	7.6	14	NW/			2	2	11
12	72	49	61	3	37	4	0	1 8	0	0	0	29.83	12	1.8	7.3	13	W/			4	4	12
13	63	49	56	-2	47	9	0	1 3 8	0	.05	0	29.90	14	3.3	6.8	21	W/			3	5	13
14	61	50	56	-1	41	9	0	3	0	.11	0	29.99	27	3.3	8.1	18	N/			1	3	14
15	61	47	54	-3	47	11	0	8	0	·0	0	30.09	21	1.5	7.6	16	W/			9	6	15
16	58	51	55	-2	50	10	0	1 8	0	.09	0	29.93	17	3.4	8.1	17	W/			10	10	16
17	58	50	54	-3	43	11	0		0	.07	0	29.81	26	10.6	11.7	26	W/			6	7	17
18	56	44	50*	-7	41	15	0		0	2.23	0	29.84	11	10.5	11.9	32	E/			9	8	18
19	56	45	51	-6	43	14	0	3	0	.15	0	29.81	08	11.4	12.1	28	E/			8	8	19
20	56	45	51	-6	44	14	0		0	.09	0	29.87	09	6.8	9.1	16	S/			9	9	20
21	56	50	53	-4	46	12	0		0	.67	0	29.70	26	10.4	14.0	35	W/			8	8	21
22	57	47	52	-5	43	13	0	8	0	0	0	29.97	22	.7	6.9	13	W/			4	4	22
23	61	44	53	-4	39	12	0		0	0	0	30.06	36	3.4	7.2	14	W/			0	2	23
24	60	50	55	-1	35	10	0		0	0	0	30.01	03	6.2	7.3	14	E/			8	9	24
25	66	48	57	1	35	8	0		0	0	0	29.98	36	4.1	7.5	13	W/			7	7	25
26	59	45	52	-4	37	13	0		0	T	0	29.91	14	.7	6.2	12	NW/			10	8	26
27	58	48	53	-3	44	12	0	8	0	T	0	29.94	33	1.5	6.8	16	W/			9	6	27
28	60	43	52	-4	43	13	0	8	0	0	0	30.02	26	1.1	7.1	13	W/			3	3	28
29	60	43*	52	-4	43	13	0	8	0	0	0	30.02	15	2.9	5.8	12	W/			0	0	29
30	69	47	58	2	45	7	0	8	0	0	0	30.01	11	2.7	8.5	17	W/			9	6	30
31	68	52	60	4	46	5	0	8	0	0	0	29.90	22	1.3	5.9	14	SW/			5	4	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	% for month	Sum	Sum	
	1958	1516				274	2	Number of days		4.12	0	29.95	34	.1	7.9	35	W/			171	161	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep.						Date:	21+	Possible		Avg.	Avg.	
	63.2	48.9	56.1	-0.8	43	7		≥ .01 inch	10	1.73										5.5	5.2	

				Season to date		Snow, ice pellets
Number of days				Total	Total	≥ 1.0 inch 0
Maximum Temp.		Minimum Temp.		418	555	Thunderstorms 3
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	Dep.	Dep.	Heavy fog X 1
0	0	0	0	-141		Clear 10 Partly cloudy 9 Cloudy 12

Greatest in 24 hours and dates Precipitation		Snow, ice pellets		Greatest depth on ground of snow, ice pellets or ice and date	
2.37	18-19	0		0	

HOURLY PRECIPITATION (Water equivalent in inches)

Date	A.M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P.M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1																									1
2								.01	.03	.17															2
3																									3
4																									4
5																									5
6																									6
7																									7
8																								T	8
9	.01	.1[illegible]	.27	.02				.01																	9
10																									10
11																									11
12																									12
13																							.05	T	13
14	.11																								14
15																									15
16											T	T	T	.01	.03	.05	T	T						T	16
17	.02	T					T	.01	.03	.01															17
18													T	T	.01	.02	.09	.07	.36	.28	.28	.36	.32	.44	18
19	.01	.05				T	.03	T	.02	.01	T	T	T	.01	.01									.01	19
20	T												T	.01	.02			.02	T	T		.04			20
21		T	.03	.13	.20	T	T	.09	.02	.01	.03	.02	.08	.04		.02									21
22																									22
23																									23
24																									24
25																									25
26												T	T	T											26
27											T	T													27
28																									28
29																									29
30																									30
31																									31

* Extreme temperatures for the month. May be the last of more than one occurrence.
− Below zero temperature or negative departure from normal.
‡ ≥ 70° at Alaskan stations.
+ Also on an earlier date, or dates.
X Heavy fog restricts visibility to ¼ mile or less.
T In the Hourly Precipitation table and in columns 9, 10, and 11 indicates an amount too small to measure.

The season for degree days begins with July for heating and with January for cooling.

Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals.

Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North; i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the / appears in Col. 17, speeds are gusts.

Any errors detected will be corrected and changes in summary data will be annotated in the annual summary.

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I certify that this is an official publication of the National Oceanic and Atmospheric Administration, and is compiled from records on file at the National Climatic Center, Asheville, I[illegible]lina 28801.

William H. Haggard
Director, National Climatic Center

SUMMARY BY HOURS

Hour Local time	AVERAGES Sky cover Tenths	Station pressure In.	Temperature Air °F	Wet bulb °F	Dew Pt. °F	Relative humidity %	Wind speed m.p.h.	Resultant wind Direction	Speed m.p.h.
01	5	29.95	53	48	43	72	6.4	06	3.3
04	5	29.94	50	46	42	74	6.9	07	4.2
07	7	29.96	50	46	41	72	7.1	08	4.0
10	6	29.99	57	50	42	61	8.4	08	2.7
13	5	29.93	62	52	43	54	9.9	24	4.7
16	5	29.92	59	53	46	64	10.4	26	7.5
19	5	29.94	56	51	46	73	7.9	26	4.2
22	5	29.96	54	49	44	70	6.2	05	2.4

USCOMM — NOAA — ASHEVILLE 400

OBSERVATIONS AT 3-HOUR INTERVALS

HOUR	SKY COVER Tenths	CEILING Hnds of ft.	VISIBILITY WHOLE MILES	VISIBILITY 10ths MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW PT. °F	REL. HUM %	WIND DIR	WIND SPEED Knots
DAY 01											
01	1	UNL	15			53	51	49	86	13	3
04	10	45	5		KH	51	50	49	93	11	4
07	9	50	12			51	49	47	86	05	5
10	5	UNL	6		KH	58	54	50	75	12	3
13	7	50	10			61	54	47	60	24	8
16	7	30	20			60	54	49	67	28	7
19	9	250	15			56	53	51	83	26	8
22	7	250	15			56	53	51	83	27	6
DAY 02											
01	9	50	15			56	53	51	83	25	5
04	9	80	10			54	52	50	86	11	7
07	10	26	7			54	52	50	86	16	6
10	10	30	7			57	56	56	96	26	10
13	4	UNL	15			62	56	51	67	26	18
16	0	UNL	20			59	52	45	60	26	18
19	1	UNL	15			57	50	43	60	36	5
22	0	UNL	15			54	48	42	64	04	5
DAY 03											
01	0	UNL	10			52	48	44	74	03	7
04	0	UNL	12			50	46	41	71	05	4
07	0	UNL	25			49	45	40	71	04	6
10	6	UNL	20			58	48	37	46	20	4
13	3	UNL	20			61	54	47	60	25	10
16	3	UNL	30			61	53	46	58	26	10
19	2	UNL	15			56	51	47	72	25	5
22	1	UNL	15			55	51	47	75	07	4
DAY 04											
01	3	UNL	8			52	49	46	80	18	3
04	2	UNL	12			49	46	44	83	09	3
07	9	250	15			50	46	41	71	11	6
10	1	UNL	3		KH	60	51	43	54	14	5
13	0	UNL	5		KH	68	57	47	47	25	7
16	0	UNL	8			62	56	51	67	26	7
19	0	UNL	6		KH	58	54	50	75	23	3
22	0	UNL	5		KH	56	53	50	80	09	6
DAY 05											
01	0	UNL	3		KH	57	52	47	69	04	4
04	0	UNL	6		KH	53	48	44	72	09	3
07	0	UNL	100			57	47	36	46	36	7
10	0	UNL	40			68	53	39	35	05	4
13	4	UNL	25			75	58	44	33	28	7
16	7	UNL	25			67	56	47	49	26	8
19	1	UNL	15			60	57	54	81	24	7
22	3	UNL	15			61	52	43	52	04	4
DAY 06											
01	1	UNL	12			60	50	40	48	35	6
04	7	UNL	15			57	49	40	53	07	6
07	10	UNL	90			56	48	39	53	06	4
10	10	UNL	50			68	53	39	35	01	7
13	9	UNL	30			73	57	44	35	26	8
16	4	UNL	40			68	57	47	47	25	8
19	0	UNL	12			59	56	54	84	23	5
22	4	UNL	12			61	54	49	65	07	5
DAY 07											
01	1	UNL	15			60	50	41	50	07	3
04	1	UNL	15			56	48	40	55	07	4
07	8	UNL	90			58	48	38	48	04	4
10	3	UNL	10			70	54	40	34	07	6
13	2	UNL	10			70	57	46	42	26	8
16	8	UNL	15			63	58	54	73	26	8
19	7	UNL	12			61	56	53	75	20	6
22	8	UNL	10			58	56	54	87	06	3
DAY 08											
01	5	UNL	5		KH	56	54	52	87	08	5
04	10	0	0		F	52	51	51	96	10	6
07	10	1	0	2	F	53	53	53	100	11	7
10	10	2	0	6	F	53	53	53	100	14	6
13	10	8	1	4	KH	57	55	54	90	25	6
16	10	250	3		KH	58	56	54	87	24	4
19	10	13	5		KH	57	55	53	87	24	4
22	10	12	6		KH	58	56	54	87	06	3
DAY 09											
01	10	9	2	8	LKH	58	56	55	90	10	4
04	10	6	5		H	57	56	55	93	09	6
07	3	35	1	8	GF	57	56	55	93	22	3
10	5	UNL	20			60	57	55	84	26	13
13	3	UNL	25			61	55	51	70	27	14
16	0	UNL	30			62	55	50	65	27	13
19	0	UNL	15			59	48	35	41	36	6
22	0	UNL	15			56	49	41	57	03	7
DAY 10											
01	1	UNL	12			54	50	47	77	04	9
04	0	UNL	10			51	47	43	74	03	4
07	0	UNL	30			51	46	40	66	11	5
10	0	UNL	8			60	51	43	54	06	5
13	0	UNL	15			68	54	41	38	25	7
16	0	UNL	25			64	54	46	52	25	9
19	0	UNL	15			58	53	49	72	01	3
22	0	UNL	12			57	50	44	62	02	4
DAY 11											
01	0	UNL	6		KH	54	48	41	62	07	4
04	0	UNL	10			53	43	31	43	36	7
07	0	UNL	50			51	42	30	45	36	6
10	0	UNL	10			63	47	28	27	02	9
13	2	UNL	30			72	51	25	17	05	6
16	7	UNL	25			67	52	37	33	30	8
19	6	UNL	15			63	46	24	23	24	8
22	2	UNL	15			57	44	28	33	07	5
DAY 12											
01	0	UNL	10			58	44	25	28	04	7
04	0	UNL	12			52	42	28	40	12	6
07	5	UNL	90			50	41	28	43	10	6
10	7	UNL	30			63	47	26	25	05	6
13	1	UNL	15			72	51	27	19	20	6
16	7	UNL	7			63	58	54	73	27	10
19	10	UNL	4		KH	57	55	54	90	22	4
22	8	UNL	2		GFK	56	54	53	90	11	6
DAY 13											
01	1	UNL	2		GFK	54	51	49	83	06	4
04	0	UNL	2		KH	49	46	44	83	10	5
07	8	12	4		KH	50	47	44	80	10	5
10	0	UNL	4		KH	57	53	49	75	07	7
13	3	UNL	5		KH	63	54	46	54	14	6
16	7	UNL	15			60	54	49	67	22	8
19	9	21	10			57	53	49	75	19	5
22	10	35	10			57	52	47	69	22	7
DAY 14											
01	8	18	8			53	50	47	80	25	6
04	1	UNL	15			51	47	43	74	33	8
07	0	UNL	20			51	44	35	54	06	6
10	0	UNL	20			57	48	38	49	34	5
13	3	UNL	15			60	51	43	54	24	9
16	1	UNL	20			59	52	45	60	27	11
19	2	UNL	15			56	49	43	62	24	4
22	9	200	15			55	45	33	43	13	7
DAY 15											
01	1	UNL	7			50	47	44	80	09	5
04	3	UNL	7			50	47	44	80	07	7
07	7	20	4		KH	49	46	43	80	07	6
10	10	250	4		KH	57	51	46	67	14	6
13	10	250	5		KH	61	56	48	63	25	7
16	10	UNL	7			59	54	50	72	26	10
19	4	UNL	7			55	52	50	83	26	8
22	2	UNL	5		KH	53	51	49	86	21	4
DAY 16											
01	7	UNL	4		KH	53	50	48	83	31	4
04	10	17	3		KH	51	49	47	86	11	5
07	10	22	1	8	KH	52	49	47	83	11	8
10	10	200	1	8	KH	55	52	49	80	12	9
13	10	6	1		RFK	56	54	53	90	15	9
16	10	4	2		RF	56	55	54	93	19	6
19	10	55	15			56	53	51	83	25	11
22	10	35	15			55	52	49	80	28	4
DAY 17											
01	10	50	7		RW	53	50	48	83	18	5
04	8	55	15			52	49	46	80	25	8
07	10	55	15		RW	53	50	47	80	25	3
10	9	50	25			54	49	45	72	26	11
13	1	UNL	30			57	50	43	60	25	16
16	1	UNL	40			55	48	41	59	26	16
19	8	35	15			53	47	40	62	27	15
22	7	35	15			53	45	37	55	31	7
DAY 18											
01	6	35	15			49	44	38	66	04	3
04	1	UNL	15			45	42	38	77	05	6
07	9	UNL	15			45	42	38	77	12	6
10	8	UNL	15			52	46	40	64	11	13
13	10	30	30		RW	55	48	40	57	14	15
16	10	28	8		R	53	47	41	64	14	12
19	10	23	4		R	49	47	45	86	10	13
22	10	15	4		R	48	46	45	89	09	15
DAY 19											
01	10	18	10			48	46	44	86	06	13
04	8	40	12			45	43	40	83	06	14
07	10	40	8		RW	46	44	42	86	09	11
10	9	40	8		RW	49	47	45	86	08	11
13	9	25	10		TRW	52	48	44	74	12	10
16	7	35	15			53	49	45	74	10	10
19	6	UNL	15			49	47	45	86	09	7
22	7	200	15			49	45	40	71	07	8
DAY 20											
01	10	40	15			49	46	42	77	05	10
04	2	UNL	15			46	44	42	86	07	5
07	7	50	90			46	43	39	77	06	10
10	10	50	15			51	47	43	74	09	8
13	10	22	15		RW	54	49	45	72	11	9
16	6	50	15			53	49	46	77	08	9
19	10	42	15		RW	53	49	46	77	16	6
22	10	22	8		RW	53	49	46	77	19	6
DAY 21											
01	10	60	15			53	48	43	69	17	9
04	10	28	6		R	53	50	47	80	18	11
07	10	15	10		RW	53	50	48	83	27	16
10	8	15	10		RW	55	51	48	77	28	18
13	10	15	10		RW	55	51	48	77	29	13
16	7	50	25			52	48	45	77	26	11
19	4	UNL	15			52	48	45	77	26	12
22	6	50	15			52	48	44	74	32	7
DAY 22											
01	7	25	15			51	47	44	77	01	4
04	9	50	12			48	46	44	86	09	6
07	2	UNL	4		KH	47	45	43	86	09	5
10	5	UNL	6		KH	51	48	45	80	11	6
13	4	UNL	15			57	49	41	55	25	10
16	2	UNL	15			57	50	43	60	25	8
19	2	UNL	15			51	47	43	74	26	6
22	1	UNL	15			51	47	44	77	05	3
DAY 23											
01	0	UNL	7			48	45	42	80	10	5
04	0	UNL	10			45	43	40	83	04	6
07	0	UNL	12			44	41	38	80	06	3
10	0	UNL	8			54	46	36	51	04	6
13	0	UNL	14			60	48	36	41	06	4
16	1	UNL	10			57	49	41	55	28	11
19	0	UNL	10			54	49	45	72	30	10
22	8	UNL	8			52	45	37	57	01	5
DAY 24											
01	10	280	12			51	44	36	57	01	6
04	10	280	15			51	43	34	52	01	9
07	10	250	50			50	43	35	57	02	8
10	7	200	30			54	45	35	49	01	6
13	9	200	20			60	48	34	38	09	6
16	10	200	30			60	48	35	39	09	5
19	10	150	15			56	47	37	49	35	6
22	7	UNL	15			53	45	36	53	03	5
DAY 25											
01	10	250	15			51	43	34	52	36	6
04	10	250	15			50	42	32	50	02	8
07	9	250	50			49	41	29	46	02	8
10	7	230	50			55	44	30	39	03	6
13	6	UNL	40			64	48	29	27	12	3
16	8	UNL	35			59	51	43	56	27	9
19	5	UNL	15			53	49	45	74	26	7
22	3	UNL	15			52	44	34	50	03	6
DAY 26											
01	3	UNL	15			48	42	34	59	12	7
04	6	UNL	15			46	40	33	61	23	3
07	9	130	25			46	40	32	58	09	5
10	10	120	25			54	44	33	45	07	8
13	10	80	12		R	58	47	34	41	31	9
16	10	80	12			57	49	40	53	26	4
19	10	60	12			56	50	44	64	19	5
22	8	120	12			54	49	44	69	23	2
DAY 27											
01	10	120	6		KH	52	48	43	72	03	4
04	8	120	5		KH	50	47	44	80	08	5
07	10	50	4		KH	48	46	43	83	10	5
10	10	50	5		KH	53	48	42	66	09	5
13	9	50	7			57	51	46	67	25	6
16	9	UNL	10			57	53	49	75	25	8
19	0	UNL	15			54	49	44	69	32	8
22	0	UNL	15			52	47	41	66	31	6
DAY 28											
01	0	UNL	15			50	46	42	74	06	5
04	4	UNL	15			44	42	40	86	07	5
07	7	UNL	6		H	43	41	39	86	15	4
10	0	UNL	3		KH	52	48	44	74	12	7
13	2	UNL	6		KH	59	51	43	56	24	7
16	5	UNL	12			57	50	44	62	28	8
19	1	UNL	15			52	49	46	80	26	8
22	1	UNL	15			52	49	46	80	33	5
DAY 29											
01	0	UNL	8			48	45	41	77	09	5
04	0	UNL	7			46	43	39	77	11	5
07	0	UNL	15			43	40	37	79	14	5
10	0	UNL	7			55	46	37	51	09	3
13	0	UNL	8			59	52	45	60	26	5
16	1	UNL	25			59	53	48	67	24	6
19	0	UNL	15			55	52	49	80	19	5
22	0	UNL	12			52	49	47	83	12	6
DAY 30											
01	0	UNL	7			48	46	44	86	11	6
04	4	UNL	5		KH	48	45	41	77	08	7
07	6	UNL	4		KH	47	44	40	77	09	6
10	10	UNL	2	8	KH	53	48	42	66	14	7
13	10	UNL	3		KH	64	52	41	43	08	11
16	2	UNL	3		KH	58	54	50	75	26	10
19	6	UNL	5		KH	54	52	50	86	24	8
22	8	160	8			56	52	49	78	01	4
DAY 31											
01	7	UNL	10			55	48	40	57	18	5
04	8	150	12			55	48	40	57	34	3
07	10	150	20			53	48	43	69	10	6
10	8	120	5		KH	60	51	42	52	12	6
13	1	UNL	4		KH	64	55	48	56	28	7
16	3	UNL	6		KH	62	55	50	65	26	7
19	0	UNL	7			57	53	50	78	21	4
22	0	UNL	5		KH	55	53	51	86	36	3

NOTES

CEILING COLUMN–

UNL indicates an unlimited ceiling.

WEATHER COLUMN–

*	Tornado
T	Thunderstorm
Q	Squall
R	Rain
RW	Rain showers
ZR	Freezing rain
L	Drizzle
ZL	Freezing drizzle
S	Snow
SP	Snow pellets
IC	Ice crystals
SW	Snow showers
SG	Snow grains
IP	Ice pellets
A	Hail
F	Fog
IF	Ice fog
GF	Ground fog
BD	Blowing dust
BN	Blowing sand
BS	Blowing snow
BY	Blowing spray
K	Smoke
H	Haze
D	Dust

WIND COLUMNS–

Directions are those from which the wind blows, indicated in tens of degrees from true North; i. e., 09 for East, 18 for South, 27 for West. Entry of 00 in the direction column indicates calm.

Speed is expressed in knots; multiply by 1.15 to convert to miles per hour.

ADDITIONAL DATA

Other observational data contained in records on file can be furnished at cost via microfilm, microfiche, or paper copies of the original records. Inquiries as to availability and costs should be addressed to: Director, National Climatic Center, Federal Building, Asheville, North Carolina 28801.

STATION: LOS ANGELES CALIFORNIA   YEAR & MONTH: 70 12

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

LOS ANGELES, CALIFORNIA
INTERNATIONAL AIRPORT
MARCH 1971

Latitude 33° 56′ N Longitude 118° 24′ W Elevation (ground) 97 ft. Standard time used: PACIFIC WBAN #23174

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog x, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 04AM In.	Precipitation: Water equivalent In.	Snow, ice pellets In.	Avg. station pressure In. Elev. 104 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	60	46	53	-3	22	12	0		0	0	0	30.01	34	11.3	14.7	40	N/			0	0	1
2	59	39*	49*	-7	18	16	0	8	0	0	0	30.28	23	3.3	6.8	18	SW/			0	0	2
3	66	43	55	-1	25	10	0		0	0	0	30.10	30	3.8	8.5	18	W/			2	1	3
4	62	47	55	-1	45	10	0	8	0	0	0	29.84	21	3.9	8.9	31	W/			0	1	4
5	65	49	57	0	40	8	0	8	0	0	0	29.97	28	5.4	10.2	30	N/			0	0	5
6	72	49	61	4	30	4	0		0	0	0	30.07	33	2.7	7.1	17	W/			1	0	6
7	70	50	60	3	31	5	0		0	0	0	29.94	29	3.9	7.9	21	W/			0	0	7
8	62	46	54	-3	48	11	0	8	0	0	0	29.91	19	2.4	7.9	17	W/			4	2	8
9	59	49	54	-3	47	11	0	8	0	0	0	30.02	23	3.6	9.4	22	W/			5	5	9
10	58	50	54	-3	47	11	0	8	0	0	0	30.01	25	5.3	7.8	18	W/			10	8	10
11	59	47	53	-4	48	12	0	8	0	0	0	29.96	21	1.9	6.9	18	W/			5	4	11
12	60	50	55	-2	51	10	0	8	0	T	0	29.92	20	3.2	9.4	21	S/			9	9	12
13	67	53	60	3	45	5	0	1	0	.23	0	29.84	27	12.6	16.1	37	NW/			2	3	13
14	61	46	54	-3	41	11	0		0	0	0	30.09	26	3.0	9.2	22	W/			5	2	14
15	66	45	56	-1	46	9	0	8	0	0	0	30.07	23	3.0	6.5	25	W/			0	0	15
16	74	50	62	5	46	3	0		0	0	0	29.96	27	5.2	7.2	18	W/			10	7	16
17	67	50	59	2	51	6	0	8	0	0	0	29.84	12	3.9	7.8	17	E/			0	1	17
18	77*	52	65*	8	51	0	0	8	0	0	0	29.97	16	.1	8.1	20	E/			6	6	18
19	67	49	58	1	50	7	0	2 8	0	0	0	29.97	26	7.0	9.4	17	W/			7	6	19
20	61	52	57	0	50	8	0	8	0	0	0	29.93	26	6.3	6.8	22	W/			4	7	20
21	60	51	56	-1	48	9	0	8	0	0	0	30.01	26	4.8	7.8	23	SW/			5	7	21
22	61	52	57	0	50	8	0	8	0	0	0	30.01	26	7.5	8.1	23	W/			6	8	22
23	60	53	57	0	51	8	0	8	0	0	0	29.94	26	4.5	5.9	17	W/			10	10	23
24	62	54	58	1	51	7	0	8	0	0	0	29.88	24	4.7	7.3	16	W/			9	9	24
25	60	54	57	0	52	8	0	8	0	0	0	29.88	27	2.6	6.5	15	W/			10	10	25
26	63	56	60	3	55	5	0	8	0	0	0	29.95	26	11.2	11.5	26	W/			8	8	26
27	62	55	59	1	54	6	0	1 8	0	0	0	29.97	25	7.4	8.2	21	W/			9	9	27
28	62	53	58	0	54	7	0	8	0	0	0	29.98	26	4.2	6.6	18	W/			6	5	28
29	65	51	58	0	54	7	0	2 8	0	0	0	29.89	24	6.5	7.6	18	SW/			5	4	29
30	65	53	59	1	52	6	0	1 8	0	0	0	29.83	16	2.5	7.6	23	W/			9	8	30
31	64	50	57	-1	52	8	0	8	0	0	0	29.88	26	6.2	6.9	20	W/			0	1	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	% for month	Sum	Sum	
	1976	1544				248	0			.23	0	29.96	26	3.9	8.4	40	N/			147	141	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.			Dep.						Date:	01	Possible		Avg.	Avg.	
	63.7	49.8	56.8	-0.2	45	-16				-1.56										4.7	4.5	

Number of days				Season to date	
Maximum Temp.		Minimum Temp.		Total	Total
				1211	31
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	Dep.	Dep.
0	0	0	0	-236	

Number of days	
Precipitation ≥ .01 inch	1
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	0
Heavy fog X	2

Clear 11 Partly cloudy 11 Cloudy 9

Greatest in 24 hours and dates			Greatest depth on ground of snow, ice pellets or ice and date	
Precipitation		Snow, ice pellets		
.23	12-13	0	0	

HOURLY PRECIPITATION (Water equivalent in inches)

Date	A. M. Hour ending at: 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at: 1	2	3	4	5	6	7	8	9	10	11	12	Date
1																									1
2																									2
3																									3
4																									4
5																									5
6																									6
7																									7
8																									8
9																									9
10																									10
11																									11
12					T	T													T	T				T	12
13	.04	.12	.06	.01																					13
14																									14
15																									15
16																									16
17																									17
18																									18
19																									19
20																									20
21																									21
22																									22
23																									23
24																									24
25																									25
26																									26
27																									27
28																									28
29																									29
30																									30
31																									31

*	Extreme temperatures for the month. May be the last of more than one occurrence.
–	Below zero temperature or negative departure from normal.
‡	≥ 70° at Alaskan stations.
+	Also on an earlier date, or dates.
X	Heavy fog restricts visibility to ¼ mile or less.
T	In the Hourly Precipitation table and in columns 9, 10, and 11 indicates an amount too small to measure.

The season for degree days begins with July for heating and with January for cooling.

Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals.

Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North; i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the / appears in Col. 17, speeds are gusts.

Any errors detected will be corrected and changes in summary data will be annotated in the annual summary.

Subscription Price: Local Climatological Data $1.00 per year including annual summary if published. Single copy: 10 cents for monthly summary; 15 cents for annual summary. Checks or money orders should be made payable and remittances and correspondence should be sent to the Superintendent of Documents, U. S. Goverment Printing Office, Washington, D. C. 20402.

I certify that this is an official publication of the National Oceanic and Atmospheric Administration, and is compiled from records on file at the Nat[illegible]matic Center, Asheville, [illegible]olina 28801.

William H. Haggard
Director, National Climatic Center

SUMMARY BY HOURS

Hour Local time	AVERAGES: Sky cover Tenths	Station pressure In.	Temperature: Air °F	Wet bulb °F	Dew Pt. °F	Relative humidity %	Wind speed m.p.h.	Resultant wind: Direction	Speed m.p.h.
01	4	29.97	53	49	45	78	5.9	08	1.2
04	6	29.95	51	48	44	80	5.5	01	1.1
07	6	29.98	51	47	42	76	6.8	03	1.7
10	5	30.00	60	52	44	62	8.1	27	2.6
13	4	29.97	62	54	47	62	12.2	25	10.8
16	4	29.93	60	53	46	64	12.7	26	11.2
19	4	29.94	55	51	47	77	9.2	25	8.0
22	4	29.97	54	51	47	78	6.7	22	2.4

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

LOS ANGELES, CALIFORNIA
INTERNATIONAL AIRPORT
JUNE 1971

Latitude 33° 56' N Longitude 118° 24' W Elevation (ground) 97 ft. Standard time used: PACIFIC WBAN #23174

Date	Temperature °F Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65° Heating	Cooling	Weather types on dates of occurrence: 1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow	Snow, ice pellets or ice on ground at 04AM In.	Precipitation Water equivalent In.	Snow, ice pellets In.	Avg. station pressure In. Elev. 104 feet m.s.l.	Wind Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Direction	Sunshine Hours and tenths	Percent of possible	Sky cover Tenths Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	67	50*	59*	-5	49	6	0		0	0	0	29.90	26	4.7	8.8	23	SW/			6	5	1
2	68	56	62	-2	51	3	0		0	0	0	29.85	24	6.2	8.6	21	W/			9	9	2
3	66	55	61	-3	52	4	0		0	0	0	29.96	25	8.6	9.6	25	W/			7	6	3
4	67	54	61	-3	54	4	0		0	0	0	29.96	26	8.0	8.6	23	SW/			1	0	4
5	69	57	63	-1	56	2	0	8	0	0	0	29.92	24	6.2	8.2	20	SW/			6	7	5
6	69	60	65	1	56	0	0	8	0	0	0	29.90	22	3.9	7.1	20	SW/			8	8	6
7	68	58	63	-1	55	2	0	8	0	0	0	29.88	25	8.6	9.2	20	W/			7	8	7
8	65	59	62	-2	56	3	0	8	0	0	0	29.87	26	4.9	7.6	16	W/			10	10	8
9	65	59	62	-2	55	3	0		0	0	0	29.83	25	8.5	8.6	16	W/			10	10	9
10	67	58	63	-1	55	2	0		0	0	0	29.82	25	4.8	6.2	15	SW/			9	9	10
11	70	59	65	1	57	0	0		0	0	0	29.86	26	8.2	8.5	21	W/			7	6	11
12	69	57	63	-1	57	2	0	1 8	0	0	0	29.90	24	10.0	10.5	22	W/			3	3	12
13	70	59	65	1	58	0	0	8	0	0	0	29.85	26	7.5	8.9	22	SW/			4	4	13
14	76	59	68	4	60	0	3	8	0	0	0	29.76	25	4.9	7.6	20	W/			0	0	14
15	70	60	65	0	61	0	0	2 8	0	0	0	29.73	24	5.2	6.9	17	W/			4	3	15
16	69	57	63	-2	60	2	0	2 8	0	0	0	29.73	25	6.7	7.8	18	W/			2	4	16
17	69	60	65	0	60	0	0	8	0	0	0	29.72	25	7.2	7.5	18	W/			4	4	17
18	70	61	66	1	59	0	1	8	0	0	0	29.80	25	6.4	7.9	21	W/			5	6	18
19	70	58	64	-1	60	1	0	2 8	0	0	0	29.84	24	5.7	6.8	18	W/			6	5	19
20	77	62	70*	5	61	0	5	8	0	0	0	29.80	25	5.5	7.9	18	W/			0	0	20
21	77*	61	69	3	62	0	4	1 8	0	0	0	29.83	23	5.5	7.8	20	SW/			2	2	21
22	72	63	68	2	61	0	3	8	0	0	0	29.83	24	7.3	8.3	21	W/			4	4	22
23	73	60	67	1	61	0	2	8	0	0	0	29.78	25	6.8	7.3	17	W/			0	1	23
24	71	64	68	2	61	0	3	8	0	0	0	29.83	25	4.9	7.5	17	W/			7	8	24
25	72	64	68	2	61	0	3	8	0	0	0	29.88	24	6.5	8.9	20	SW/			7	8	25
26	72	63	68	1	60	0	3	8	0	0	0	29.84	24	6.4	8.9	20	W/			9	9	26
27	71	63	67	0	60	0	2	8	0	0	0	29.79	24	6.1	7.8	23	W/			9	9	27
28	72	62	67	0	57	0	2		0	0	0	29.84	25	8.9	9.2	21	W/			4	5	28
29	72	61	67	0	58	0	2	8	0	0	0	29.88	25	7.8	9.6	22	W/			3	3	29
30	70	59	65	-3	58	0	0		0	0	0	29.85	24	6.9	7.5	23	SW/			2	2	30

Sum	Sum				Total	Total		Total	Total	For the month:						Total	% for month	Sum	Sum
2103	1778				34	33	Number of days	.00	0	29.84	25	6.6	8.2	25	W/			155	158
Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation ≥ .01 inch 0	Dep.						Date:	03	Possible		Avg.	Avg.
70.1	59.3	64.7	-0.1	58	-20			-0.05										5.2	5.3

Number of days				Season to date			
Maximum Temp.		Minimum Temp.		Total	Total	Snow, ice pellets ≥ 1.0 inch	0
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	1566	100	Thunderstorms	0
0	0	0	0	Dep.	Dep.	Heavy fog X	3
				-233		Clear 9 Partly cloudy 14 Cloudy 7	

Greatest in 24 hours and dates Precipitation		Snow, ice pellets		Greatest depth on ground of snow, ice pellets or ice and date	
0		0		0	

HOURLY PRECIPITATION (Water equivalent in inches)

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1																									1
2																									2
3																									3
4																									4
5																									5
6																									6
7																									7
8																									8
9																									9
10																									10
11																									11
12																									12
13																									13
14																									14
15																									15
16																									16
17																									17
18																									18
19																									19
20																									20
21																									21
22																									22
23																									23
24																									24
25																									25
26																									26
27																									27
28																									28
29																									29
30																									30

*	Extreme temperatures for the month. May be the last of more than one occurrence.
–	Below zero temperature or negative departure from normal.
‡	≥ 70° at Alaskan stations.
+	Also on an earlier date, or dates.
X	Heavy fog restricts visibility to ¼ mile or less.
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Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals.

Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North; i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the / appears in Col. 17, speeds are gusts.

Any errors detected will be corrected and changes in summary data will be annotated in the annual summary.

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I certify that this is an official publication of the National Oceanic and Atmospheric Administration, and is compiled from records on file at the National Climatic Center, Asheville, N lina 28801.

William H. Haggard
Director, National Climatic Center

SUMMARY BY HOURS

Hour Local time	AVERAGES Sky cover Tenths	Station pressure In.	Temperature Air °F	Wet bulb °F	Dew Pt. °F	Relative humidity %	Wind speed m.p.h.	Resultant wind Direction	Speed m.p.h.
01	6	29.83	61	59	57	88	4.9	24	3.3
04	7	29.82	60	58	57	89	4.7	21	.8
07	6	29.85	62	59	57	85	5.4	15	1.7
10	6	29.87	67	62	58	74	9.2	25	8.9
13	4	29.86	69	63	59	69	12.9	25	12.7
16	4	29.83	68	62	59	72	12.8	25	12.6
19	4	29.82	63	60	58	82	9.5	25	9.3
22	4	29.84	62	59	57	86	6.1	24	5.4

USCOMM — NOAA — ASHEVILLE 400

OBSERVATIONS AT 3-HOUR INTERVALS

HOUR	SKY COVER Tenths	CEILING Hnds of ft	VISIBILITY WHOLE MILES	VISIBILITY 16ths MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW PT. °F	REL. HUM %	WIND DIR	WIND SPEED Knots	SKY COVER Tenths	CEILING Hnds of ft	VISIBILITY WHOLE MILES	VISIBILITY 16ths MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW PT. °F	REL. HUM %	WIND DIR	WIND SPEED Knots	SKY COVER Tenths	CEILING Hnds of ft	VISIBILITY WHOLE MILES	VISIBILITY 16ths MILE	WEATHER	TEMPERATURE AIR °F	TEMPERATURE WET BULB °F	TEMPERATURE DEW PT. °F	REL. HUM %	WIND DIR	WIND SPEED Knots
					DAY 01											DAY 02											DAY 03						
01	0	UNL	15			54	51	49	83	10	6	10	250	14			56	54	52	87	18	6	10	42	14			57	53	50	78	26	6
04	0	UNL	15			52	49	47	83	03	4	10	250	14			56	53	51	83	16	5	10	33	14			57	53	50	78	26	5
07	8	UNL	8			57	52	47	69	07	4	10	18	12			57	54	51	80	06	4	9	45	15			61	55	50	67	12	4
10	9	250	7			64	55	48	56	28	5	10	25	15			60	55	51	72	24	8	9	45	15			62	55	50	65	25	8
13	2	UNL	10			65	57	50	59	24	15	9	28	15			67	58	51	57	24	12	2	UNL	8			66	59	54	65	25	13
16	3	UNL	12			63	57	52	68	27	12	8	250	20			66	58	51	59	25	11	4	UNL	14			64	58	54	70	25	15
19	5	UNL	20			58	53	48	70	26	11	5	UNL	15			59	55	51	75	27	9	6	180	14			58	55	53	84	26	9
22	8	UNL	15			56	53	51	83	23	4	8	40	15			57	53	50	78	26	5	0	UNL	12			57	54	51	80	25	7
					DAY 04											DAY 05											DAY 06						
01	0	UNL	14			55	53	52	90	26	4	0	UNL	8			57	56	55	93	24	5	10	15	6		KH	60	58	56	87	12	2
04	0	UNL	14			54	52	51	90	24	5	10	14	7			57	56	56	96	13	4	10	16	6		KH	60	57	55	84	04	5
07	0	UNL	12			59	56	54	84	27	7	10	17	4		KH	59	57	55	87	11	5	10	16	4		KH	60	57	55	84	15	7
10	0	UNL	10			64	59	55	73	26	9	10	23	5		KH	64	59	56	75	24	6	10	22	5		KH	64	59	55	73	20	3
13	0	UNL	10			67	59	53	61	25	13	1	UNL	7			69	62	57	66	25	13	4	UNL	6		KH	68	61	56	66	24	12
16	2	UNL	15			65	60	56	73	23	9	2	UNL	7			60	60	56	70	25	12	7	220	8			67	61	56	68	25	10
19	3	UNL	12			61	58	55	81	25	8	3	UNL	7			60	58	56	87	24	8	9	16	6		KH	61	58	56	84	27	5
22	0	UNL	10			58	56	55	90	32	5	10	13	5		KH	59	57	56	90	24	4	10	16	5		KH	61	58	56	84	18	5
					DAY 07											DAY 08											DAY 09						
01	10	15	5		KH	61	58	56	84	24	7	10	21	10			59	57	56	90	33	4	10	33	8			60	58	56	87	26	7
04	10	21	7			61	57	54	78	18	5	10	22	8			59	57	55	87	33	3	10	28	8			59	57	56	90	24	5
07	10	23	9			61	56	53	75	22	4	10	21	5		KH	61	58	55	81	12	7	10	33	7			59	57	56	90	26	9
10	10	25	9			64	59	55	73	24	7	10	17	7			61	58	56	84	29	6	10	30	7			63	58	55	75	24	7
13	10	28	9			67	60	55	66	26	12	10	18	8			63	59	56	78	24	8	10	30	10			62	58	55	78	24	9
16	3	UNL	6		H	65	60	57	75	25	11	10	25	10			63	59	57	81	27	9	10	30	8			62	57	54	75	25	10
19	6	10	8			60	58	56	87	26	9	10	30	12			61	58	56	84	26	8	10	45	10			60	57	54	81	26	9
22	4	UNL	10			59	57	56	90	26	9	10	30	10			61	58	56	84	24	8	10	35	12			59	56	54	84	24	4
					DAY 10											DAY 11											DAY 12						
01	10	25	10			59	57	55	87	26	6	10	15	10			61	58	56	84	27	5	0	UNL	8			59	57	56	90	23	5
04	10	45	10			58	56	54	87	34	4	10	24	10			61	58	56	84	25	5	4	UNL	7			58	57	56	93	23	4
07	10	33	8			59	56	54	84	10	3	10	27	7			61	58	56	84	31	5	10	10	4		FK	60	59	58	93	25	6
10	10	25	10			62	58	56	81	26	6	6	45	10			67	61	58	68	27	5	3	UNL	5		KH	66	61	58	76	24	11
13	10	30	12			65	60	56	73	25	7	10	45	8			66	62	58	71	25	11	0	UNL	7			68	62	58	71	25	14
16	10	33	15			63	59	56	78	24	6	5	UNL	8			67	62	59	76	26	12	0	UNL	8			68	63	59	73	26	14
19	3	UNL	12			62	58	56	81	24	7	0	UNL	8			62	59	57	84	26	10	0	UNL	12			62	59	57	84	24	12
22	10	45	12			61	58	56	84	25	4	1	UNL	7			60	59	58	93	26	6	0	UNL	7			61	59	57	87	19	7
					DAY 13											DAY 14											DAY 15						
01	7	17	7			59	58	57	93	27	6	0	UNL	8			61	60	59	93	28	2	0	UNL	8			62	61	60	93	22	3
04	10	11	6		KH	59	58	57	93	30	7	0	UNL	7			59	58	57	93	10	3	10	0	0		FK	60	60	60	100	09	4
07	10	10	3		KH	61	59	58	90	01	4	0	UNL	4		KH	64	62	60	87	10	5	10	3	0	8	FK	60	60	60	100	13	3
10	1	UNL	3		KH	68	63	59	73	26	10	0	UNL	4		KH	73	66	62	69	24	8	1	UNL	2	8	KH	67	63	61	81	25	10
13	2	UNL	4		KH	69	63	60	73	25	12	0	UNL	5		KH	72	66	62	71	27	12	0	UNL	3		KH	70	65	62	76	25	10
16	9	8	3		KH	64	61	59	84	25	12	0	UNL	7			74	65	60	62	27	12	2	UNL	3		KH	70	65	62	76	25	10
19	0	UNL	8			62	60	58	87	23	9	0	UNL	20			67	62	58	73	23	7	10	8	5		FK	64	62	61	90	23	6
22	0	UNL	8			61	59	57	87	20	2	0	UNL	12			64	62	60	87	19	4	0	UNL	7			61	60	59	93	24	2
					DAY 16											DAY 17											DAY 18						
01	0	UNL	5		KH	61	60	59	93	25	3	9	9	6		KH	62	61	60	93	22	3	4	UNL	8			62	60	59	90	26	3
04	9	UNL	0	6	FK	57	57	57	100	26	2	0	UNL	5		KH	60	59	59	97	24	3	10	8	6		KH	61	60	59	93	18	3
07	2	UNL	2		KH	64	62	61	90	14	5	3	UNL	2		KH	63	62	61	93	22	5	10	12	4		KH	63	61	59	87	08	4
10	1	UNL	2		KH	69	64	61	76	26	8	8	10	2		KH	67	63	60	78	24	8	1	UNL	3		KH	70	64	60	71	26	10
13	10	3	2	8	KH	69	64	61	76	26	11	3	UNL	3		KH	69	63	60	73	25	9	1	UNL	3		KH	70	64	60	71	26	12
16	5	UNL	7			68	63	60	76	26	12	0	UNL	4		KH	69	63	59	71	27	10	5	UNL	4		KH	68	63	59	73	24	13
19	2	UNL	7			64	62	60	87	25	9	6	8	5		KH	64	61	59	84	24	8	8	12	5		KH	63	61	59	87	26	5
22	7	8	8			63	61	60	90	22	4	3	UNL	8			62	60	59	90	25	6	4	UNL	5		KH	61	60	59	93	25	5
					DAY 19											DAY 20											DAY 21						
01	6	7	4		KH	60	59	58	93	24	5	0	UNL	5		KH	63	61	60	90	26	3	0	UNL	8			63	61	60	90	00	0
04	5	UNL	1		FK	59	59	59	100	03	3	0	UNL	4		KH	62	60	59	90	09	4	0	UNL	7			62	61	60	93	23	4
07	10	6	0	12	FK	61	60	60	97	18	3	0	UNL	5		KH	66	63	62	87	07	4	9	5	1	8	FK	62	61	61	97	07	8
10	8	UNL	1	8	KH	68	64	61	78	25	7	1	UNL	3		KH	75	67	63	66	25	8	0	UNL	4		KH	75	68	64	69	24	8
13	7	UNL	1	8	KH	70	64	61	73	24	11	1	UNL	3		KH	77	68	63	62	25	10	3	UNL	6		KH	74	67	63	69	23	11
16	4	UNL	3		KH	69	63	60	73	23	7	0	UNL	12			74	66	62	66	26	13	1	UNL	12			74	66	62	66	24	10
19	0	UNL	4		KH	65	62	60	84	24	6	0	UNL	15			69	63	60	73	25	7	5	UNL	8			68	64	62	81	24	8
22	0	UNL	6		KH	63	61	60	90	24	5	0	UNL	15			65	62	60	84	23	6	3	UNL	7			65	63	61	87	24	5
					DAY 22											DAY 23											DAY 24						
01	4	UNL	4		KH	65	63	61	87	18	4	1	UNL	10			61	59	57	87	25	4	10	9	5		KH	65	62	60	84	05	2
04	10	8	4		KH	65	63	62	90	22	2	0	UNL	8			61	59	58	90	25	4	10	9	4		KH	64	61	59	84	09	5
07	10	10	2		KH	66	63	62	87	31	4	0	UNL	7			65	62	60	84	26	3	6	UNL	2		KH	64	62	60	87	15	3
10	3	UNL	2		KH	71	67	64	79	27	11	0	UNL	8			73	66	61	66	24	8	10	14	1	8	KH	68	64	61	78	26	10
13	1	UNL	3		KH	71	65	61	71	24	10	0	UNL	8			73	66	62	69	24	11	5	UNL	3		KH	71	65	62	73	26	8
16	0	UNL	12			71	64	60	68	25	12	0	UNL	5		KH	73	67	63	71	26	10	4	UNL	5		KH	71	65	62	73	26	10
19	0	UNL	15			67	62	58	73	24	9	0	UNL	8			68	64	62	81	27	7	6	12	4		KH	66	62	60	81	25	8
22	0	UNL	10			64	61	59	84	21	6	6	10	8			66	63	62	87	18	4	10	11	4		KH	65	63	61	87	24	6
					DAY 25											DAY 26											DAY 27						
01	10	12	4		KH	65	63	61	87	20	3	10	13	4		KH	64	62	60	87	06	4	10	12	6		KH	63	61	59	87	20	4
04	10	10	4		KH	65	62	60	84	14	4	10	15	4		KH	65	62	60	84	14	5	10	15	6		KH	63	61	60	90	10	4
07	10	12	2		KH	65	62	60	84	10	5	10	16	2	8	KH	65	62	60	84	20	4	8	19	5		KH	64	60	58	81	17	4
10	10	16	3		KH	68	64	61	78	24	9	10	18	2	8	KH	67	63	61	81	23	9	10	20	7			67	63	61	81	24	8
13	1	UNL	5		KH	72	65	61	68	26	11	8	18	5		KH	71	65	61	71	24	11	2	UNL	7			70	64	61	73	23	11
16	4	UNL	5		KH	71	65	62	73	25	13	10	11	4		KH	69	65	62	79	26	13	10	12	6		KH	68	64	61	78	26	14
19	10	9	2	8	KH	66	63	61	84	25	9	10	9	4		KH	65	62	60	84	27	9	10	10	3		KH	65	62	60	84	26	5
22	10	10	4		KH	65	62	60	84	28	8	10	12	5		KH	63	61	59	87	27	7	10	13	7			64	61	59	84	25	4
					DAY 28											DAY 29											DAY 30						
01	10	20	8			64	58	54	70	26	7	9	11	10			63	60	58	84	22	4	0	UNL	10			60	58	57	90	24	5
04	10	18	10			64	59	56	75	26	7	10	14	10			61	59	57	87	05	4	0	UNL	10			59	57	56	90	00	0
07	5	UNL	10			66	61	57	73	23	4	10	19	7			63	59	57	81	17	5	10	12	7			63	60	58	84	17	4
10	10	25	10			69	63	59	71	24	9	3	UNL	7			71	63	58	64	25	9	0	UNL	7			68	63	60	76	25	8
13	0	UNL	12			72	64	59	64	23	12	0	UNL	7			72	64	59	64	24	13	0	UNL	8			70	64	60	71	23	12
16	0	UNL	12			70	64	60	71	27	9	0	UNL	10			71	64	60	68	26	12	0	UNL	8			68	62	58	71	24	10
19	0	UNL	10			65	60	57	75	24	11	0	UNL	15			65	60	57	75	26	13	0	UNL	10			64	60	58	81	27	8
22	0	UNL	10			63	59	57	81	24	5	0	UNL	15			63	59	57	81	24	7	0	UNL	10			62	59	57	84	23	5

NOTES

CEILING COLUMN—

UNL indicates an unlimited ceiling.

WEATHER COLUMN—

•	Tornado
T	Thunderstorm
Q	Squall
R	Rain
RW	Rain showers
ZR	Freezing rain
L	Drizzle
ZL	Freezing drizzle
S	Snow
SP	Snow pellets
IC	Ice crystals
SW	Snow showers
SG	Snow grains
IP	Ice pellets
A	Hail
F	Fog
IF	Ice fog
GF	Ground fog
BD	Blowing dust
BN	Blowing sand
BS	Blowing snow
BY	Blowing spray
K	Smoke
H	Haze
D	Dust

WIND COLUMNS—

Directions are those from which the wind blows, indicated in tens of degrees from true North; i. e., 09 for East, 18 for South, 27 for West. Entry of 00 in the direction column indicates calm.

Speed is expressed in knots; multiply by 1.15 to convert to miles per hour.

ADDITIONAL DATA
Other observational data contained in records on file can be furnished at cost via microfilm, microfiche, or paper copies of the original records. Inquiries as to availability and costs should be addressed to: Director, National Climatic Center, Federal Building, Asheville, North Carolina 28801.

STATION: LOS ANGELES CALIFORNIA   YEAR & MONTH: 71 06

APPENDIX B

PUBLIC ATTITUDE SURVEY ADMINISTRATION

Public attitude survey instructions to interviewers.

Public attitude survey questionnaire.

PUBLIC OPINION SURVEY OF ODOR POLLUTION PROBLEMS
INSTRUCTIONS TO INTERVIEWERS

This survey is basically a study of public attitudes concerning odor problems as a form of air pollution in selected areas of Los Angeles County, California. It is part of a study being conducted by Copley International Corporation for the National Air Pollution Control Administration. However, we do not wish the sponsor of the survey to be known as this may tend to bias respondent answers.

It might be necessary in some cases to take definite steps to assure respondents that no one will contact them to buy anything. Also, you might find it necessary to say that the information they give becomes part of a statistical summary and individual responses will not be exposed or revealed in any way.

What Numbers to Call. Each questionnaire will have a telephone number written on it. This is the only number you should call. Numbers should not be substituted.

Make all the necessary notations in the spaces provided on the questionnaire for the results to each call. Space is provided for recording data for an initial and five follow-up calls. Just prior to starting the interview, write in the date and starting time. When you have completed an interview, make a check mark under "Interview Completed." Make a check mark under "Interview Not Completed" for each call for which an interview is not obtained.

Space is provided to record the best time to call in order to find the proper respondent at home. This information may be obtained from other members of the household who answer the call.

Space is also provided to record reasons why the interview was not completed, such as: no answer, disconnected, refused, language problem, etc.

Whom to Interview. Interviews should be divided as evenly as possible between men and women. Make alternate interviews with the male head of the household ("man of the house") and the wife of the head of the household ("lady of the house"). Children, relatives, and friends living in the household should not be interviewed. When there is only one head of household, such as a single man or single woman, a widow, a divorcee, etc., then interview that person.

Remember, when interviewing a household that has both a man and a woman available as possible respondents, alternate your selection of respondents in order to maintain an approximate 50-50 ratio between men and women.

When to Call. Do not make any calls before 9:00 a.m. or after 9:30 p.m. unless you have been instructed to call back at a specific time. Interviews will be conducted only on specified dates. In order to balance your quota by sex, you might have to make many follow-up calls in the evenings. In making your follow-up calls, select a different time of day and, where possible, an alternate (specified) interviewing day. In other words, spread out the calls as much as possible to afford a greater opportunity of catching respondents at home.

General Questionnaire Instructions. Questions are to be asked exactly as they are written. If a respondent indicates he does not understand a question, reread the question slowly.

Where a question is followed by three periods (for example, "Would you rate it...?"), read the answers provided in the order they are listed, but do not read the answer numbers. Never read the response "Don't Know." This is included for your convenience to check, if appropriate.

Where a question does not have three periods at the end of it, do not read the responses. In this case, simply check the number of the answer that corresponds to the respondent's reply.

Check the number of the response given or write in the respondent's answer in the appropriate space. Do not mark anything on the lines numbered 2 through 73 in the extreme right-hand margin of the paper.

Words and phrases which are underlined should be stressed. For instance, the major portion of the questionnaire is concerned with the particular area of the city in which the respondent lives, not the entire city as a whole. Therefore, in many questions the words your area of the city are underlined and should be stressed.

The study is concerned with major odor pollution problems. Be sure the respondent does not misunderstand your questions. We are not interested in odors produced from cooking in his own kitchen, or from a neighbor who burns a pile of leaves once a year, or a neighbor boy who has an old car with a smoky exhaust, etc. We are interested in odors produced by factories, sewers, disposal areas, stockyards, large bodies of stagnant water, and any other industrial or natural source which is a recognized irritation in the selected areas of the County.

A telephone number will already have been written on the front page of each questionnaire. After you finish an interview, fill in the respondent's name and address. Also write in the name of the respondent's city (Hawthorne, Torrance, etc.). After the interview is completed, sign your name on the last page.

Read all questions slowly and clearly, placing emphasis on words and phrases which are underlined.

Q1) After this question is read, read each of the five alternative answers (do not read "Don't Know"), emphasizing each one and pausing between each one. That is, read "Would you rate it...Excellent, Good, Fair, Poor, or Very Poor?"

Q2) Read the question as is, but do not read the responses. If the respondent answers "Yes," then ask "What are they?" Do not read any of the answers provided under this question. Check categories 1-4 only if these are specifically mentioned by the respondent. Write down any other answer or any answer you are not sure how to categorize in the space provided next to "Other." If the respondent mentions more than one thing his neighbors complain about, indicate each of the things he says.

Q3A) On this question, read the three alternative answers slowly and carefully so that the respondent can fix them in his mind. In some cases, it may be necessary to repeat the alternative answers for the first two or three parts of the question. For each problem, check one response only. For example, "Water Pollution" may be answered either "Serious," or "Somewhat Serious," or "Not Serious," or "Don't Know," but only one of these should be checked.

Q3B) If the respondent says there are other "serious" or "somewhat serious" problems, ask "What are they?" and record all that he says in the space provided.

Q4A & Q4B) Do not read the responses to this question. If "Yes" is the answer, ask "What are they?" but do not read the following list of responses. Here again, write down any other answer or any answer you are not sure how to categorize in the space provided next to "Other." If the respondent mentions more than one condition, indicate each of the things he says.

Q5A) Read the alternative answers slowly and carefully, repeating them if necessary. For each item, check one response only. For example, "Smoke" may be answered either "Yes," or "No," or "Don't Know," but only one of these responses should be checked.

Q5B) Do not read the responses at first. If "Yes" is the answer, ask "Which one is the worst?" You may read the list of responses if the respondent does not remember them or asks you to say them again. Check all the items that are mentioned.

Q6A) Insert the name of the area of the city you are calling. Do not read the responses to this question. If the answer is "No" or "Don't Know," skip parts B, C, D and E.

Q6B) Do not read the responses to this question. If "No" is the answer, skip part C and ask parts D and E. If the answer is "Yes," ask "How much would you say it has bothered you? Is it...Very Much, Much, Moderately, Little, or Very Little?" Do not read "Don't Know." Read the five alternatives slowly and carefully. Repeat them if necessary. Check only one answer.

Q6C) Ask the question, including the responses. Read each response slowly and carefully. Repeat them if necessary. Check only one answer.

Q6D) Ask the question as is. Do not read the responses. Before you begin interviewing, you will be told the industry or type of plant(s) we are investigating. If the respondent mentions this type of industry or a particular company engaged in this type of processing, check "Plant being investigated." Any other type of factory noise should be noted as "Other Factory." Accept only one answer to this question, as we are interested in the source of most of the noise.

Q6E) Read this question with the responses. Read each response slowly and carefully, with a pause between each answer. Repeat if necessary. Check only one answer.

Q7A) Do not read the responses to this question. If the answer is "No" or "Don't Know," skip parts B, C, D, E, F, G and H.

Q7B) Do not read the responses to this question. If the answer has to do with the direction the wind is blowing, write the wind direction in on the line provided. If the answer has to do with a particular process that a factory performs, write the name of the process on the line provided. We are interested in when odors are noticed most. Check only one answer.

Q7C) Ask this question and read the first four responses slowly and carefully. Do not read "Don't Know." Repeat the answer if necessary or if the respondent says something other than these four responses.

Q7D) Do not read the responses to this question. Check only one answer.

Q7E) Do not read the responses to this question. If "No" is the answer, skip part F and ask parts G and H. If "Yes" is the answer, ask "How much would you say they have bothered you? Is it...Very Much, Much, Moderately, Little, or Very Little?" Do not read "Don't Know." Read these five alternatives slowly and carefully. Repeat them if necessary. Check only one answer.

Q7F) Read the question and each response slowly and carefully. Do not read "Don't Know." Repeat the responses if necessary. Check only one answer.

Q7G) Do not read the responses to this question. If the respondent mentions the industry under investigation or a particular company engaged in this type of processing, check "Plant being investigated." Any other type of factory odor should be noted as "Other factory." Accept only one answer to this question.

Q7H) Read this question with the responses. Pause between each answer. Repeat if necessary. Check only one answer.

Q8) Ask this question without the responses. If the answer is either "Good" or "Bad," ask "Why is that?" In an open-ended question such as this, it is permissible and desirable to probe for additional answers, using a phrase such as: "Can you think of any other reasons?"

Q9A) Do not read the responses to this question. If the answer is "No," skip part B. If the answer is "Yes," ask "Which problem?" You may clarify this question by reading "Noise" or "Odor pollution" if necessary. If the respondent refuses to tell you if he has contacted some authority, go on to part B.

Q9B) Do not read the responses to this question. The respondent may have contacted more than one agency and, if so, check all of the ones he mentions.

Q10A) Do not read the responses. If the answer is "Yes," ask "Which problem?" You may read "Noise" or "Odor pollution" if necessary.

Q10B) Do not read the responses to this question.

Q11A) Do not read the responses to this question. If the answer is "No" or "Don't Know," skip parts B, C, D, E, F and G.

Q11B) Do not read the responses. If the answer is "No" or "Don't Know," skip parts C and D.

Q11C) Do not read the responses. Check as many answers as the respondent gives.

Q11D,
Q11E,
Q11F) Do not mark $0 unless the respondent actually says "Nothing" or "It hasn't" or something similar. If he cannot give you a figure, check "Don't Know/ Refused."

Q11G) Do not read the responses to this question. Check only one answer.

Q12) Do not read the responses.

Q13) This is an open-ended question and probes such as "Can you think of any others?" are desirable. Record any examples mentioned.

Q14) Do not read the responses.

Q15) Do not read the responses. If the answer is "Yes," ask "In what way?" and probe for examples.

Q16) Ask this question and read the responses slowly and carefully. Repeat them if necessary. Do not read "Don't Know." Check only one answer.

Q17) Do not mark $0 unless the respondent actually says "Nothing" or "I wouldn't be willing to pay for it" or something similar. If he cannot give you a figure, check "Don't Know."

Q18-Q23) These are personal data questions necessary for our statistical analyses. Most people will readily give this information once the interviewer has established rapport and the respondent feels assured the interview is legitimate. However, there is always a small segment of the population who will refuse. Do not pressure them to give this information if they are strongly inclined not to do so.

Q19A) With this question, we are interested in the person's job title. If he does not provide this information, you may probe further by asking such questions as "What is your occupation?" or "What type of job is that?" Write in the job title on the line provided, but do not check the appropriate category.

Q19B) Write in the industry on the line provided, but do not check the appropriate category.

Finally, determine respondent's name and address and record this on the front page. Check the sex on question 24, and terminate the interview by thanking the respondent for his time and opinions. Be sure to sign your name on the last page.

PUBLIC OPINION SURVEY OF
ODOR POLLUTION PROBLEMS

OMB No. 85-S70035
Approval Expires 6/30/71

Project No. (2-5) ____________

Area No. (6) ____________

Respondent No. (7-10) ____________

Respondent:

Phone No. ____________

Street Address ____________

City ____________ ____________

Name ____________

Record of Calls:

Call	Date	Time	Interview Completed	Interview Not Completed	Best Time to Find Respondent at Home	Reason If Not Completed
1st	____	____	( )	( )	____________	____________
2nd	____	____	( )	( )	____________	____________
3rd	____	____	( )	( )	____________	____________
4th	____	____	( )	( )	____________	____________
5th	____	____	( )	( )	____________	____________
6th	____	____	( )	( )	____________	____________

"Hello. My name is (name) ____________ with (research firm) ____________. I'm calling (long distance) for a governmental agency interested in community problems. I'd like to talk with the man/lady of the house to get his/her opinion on several questions." (ESTABLISH IF SPEAKER IS THE RESPONDENT YOU SEEK. IF NOT, ASK IF RESPONDENT CAN BE CALLED TO THE PHONE.)

Q1) In general, how would you rate your area of the city as a place to live? Would you rate it . . . ?

_____ 1 Excellent
_____ 2 Good
_____ 3 Fair
_____ 4 Poor
_____ 5 Very Poor
_____ 6 Don't Know

11 ________

*Q2) Can you think of any annoying things in your area that your neighbors complain about?

_____ 1 No
_____ 2 Yes (ASK: What are they?)
_____ 3 Don't Know

12 ________

_____ 1 Air pollution or odors
_____ 2 Crime or area has deteriorated
_____ 3 Water pollution
_____ 4 Airport, industrial or traffic noise
_____ 5 Other ____________
____

13 ________

Q3A) Here are a few problems which different community areas are facing. How would you rate each of these for your area of the city today in terms of being serious, somewhat serious, or not serious?

	Serious 14	Somewhat Serious 15	Not Serious 16	Don't Know 17	
Water pollution	______1	______1	______1	______1	14______
Noise in the community	______2	______2	______2	______2	
Crime	______3	______3	______3	______3	15______
Deterioration of streets, parks, utilities, public buildings, etc.	______4	______4	______4	______4	16______
Air pollution	______5	______5	______5	______5	17______
Deterioration of stores, homes, industrial buildings, etc.	______6	______6	______6	______6	

B) Are there any other problems that you think are serious or somewhat serious in your community?

______1 No ______2 Yes (ASK: What are they?)______________________ 18______

______________________ 19______

*Q4A) Are there any conditions in your neighborhood that would cause you to spend your leisure time inside your home rather than outside in the yard, neighborhood parks, etc.?

______1 No ______2 Yes (ASK: What are they?) ______3 Don't Know 20______

______1 Odors

______2 Noise

______3 Cold weather or wind 21______

______4 Other______________________

*B) Are there any conditions in your neighborhood that would cause you to spend your leisure time away from your home?

______1 No ______2 Yes (ASK: What are they?) ______3 Don't Know 22______

______1 Odors

______2 Noise

______3 Cold weather or wind 23______

______4 Other______________________

Q5A) What do the words "air pollution" mean to you? Please answer "Yes" or "No" to the following. Do they mean . . . ?

	Yes 24	No 25	Don't Know 26	
Smoke	___1	___1	______1	24______
Dust	___2	___2	______2	
Haze	___3	___3	______3	25______
Fog	___4	___4	______4	26______
Noticeable odors	___5	___5	______5	
Irritation of the eyes	___6	___6	______6	
Irritation of the nose or throat	___7	___7	______7	

B) Are any of these a problem in your area of the city?

________ 1 No ________ 2 Yes (ASK: Which one is the worst?) ________ 3 Don't Know 27________

________ 1 Smoke
________ 2 Dust
________ 3 Haze
________ 4 Fog
________ 5 Noticeable odors 28________
________ 6 Irritation of the eyes
________ 7 Irritation of the nose or throat

Q6A) Some people here in (name of city)________________ have been complaining recently about noise. Have you noticed noise in your neighborhood during the last three months?

________ 1 No (SKIP TO Q7A) ________ 2 Yes (ASK FOLLOWING) 29________
________ 3 Don't Know (SKIP TO Q7A)

B) Would you say that noise has bothered you?

________ 1 No (SKIP TO Q6D) ________ 2 Yes (ASK: How much would you say it has bothered you? Is it . . . ?) 30________

________ 1 Very much ________ 2 Much
________ 3 Moderately ________ 4 Little 31________
________ 5 Very little ________ 6 Don't Know

C) How often has noise bothered you? Is it . . . ?

________ 1 Very often ________ 2 Often ________ 3 About half the time 32________
________ 4 Infrequently ________ 5 Very infrequently ________ 6 Don't Know

D) Could you tell me where most of this noise comes from, that is, who or what causes it?

________ 1 Airplanes ________ 2 Plant being investigated
________ 3 Other factory ________ 4 Traffic
________ 5 Other____ 33________
________ 6 Don't Know

E) In your area of the city, would you say that noise is . . . ?

________ 1 Not a serious problem at all
________ 2 A more serious problem than it was a year ago
________ 3 A less serious problem than it was a year ago 34________
________ 4 A continuous and serious problem for over a year that has not gotten worse or better

Q7A) Some people have also complained about odor pollution. Have you noticed any odors in your neighborhood in the last three months?

________ 1 No (SKIP TO Q9A) ________ 2 Yes (ASK FOLLOWING) 35________
________ 3 Don't Know (SKIP TO Q9A)

*B) Have you noticed odors most during the morning, the afternoon, the evening, or any other particular time?

________1 During the morning

________2 During the afternoon

________3 During the evening

________4 When the air is still

________5 When the wind blows from the ________________________

________6 When the plant does ________________________

________7 All/most of the time

________8 Have not noticed it at a particular time

________9 Other ________________________

________10 Don't Know

36 ________

C) How often have you noticed these odors? Is it . . . ?

________1 Everyday

________2 At least once a week

________3 At least once a month

________4 Only occasionally (less than once a month)

________5 Don't Know

37 ________

D) Generally speaking, how long do these odors last?

________1 All the time

________2 Two or three days

________3 One day

________4 More than one hour, but less than one day

________5 One hour or less

________6 Other ________________________

________7 Don't Know

38 ________

E) Would you say that these odors have bothered you?

________1 No (SKIP TO Q7H)

________2 Yes (ASK: How much would you say they have bothered you? Is it . . . ?)

39 ________

________1 Very much

________2 Much

________3 Moderately

________4 Little

________5 Very little

________6 Don't Know

40 ________

F) How often have these odors bothered you? It is . . . ?

________1 Very often

________2 Often

________3 About half the time

________4 Infrequently

________5 Very infrequently

________6 Don't Know

41 ________

G) What bothers you most about these odors? Would you say that it is . . . ?

________1 The number of times that you notice odors

________2 The strength of the odors in the air

________3 The length of time that the odors last

________4 Don't Know

42 ________

H) Could you tell me where most of these odors originate, that is, who or what causes them?

________ 1 Plant being investigated

________ 2 Other factory

________ 3 Swamp/bay/river

________ 4 Dump/incinerator/sewerage treatment

________ 5 Motor vehicle exhaust

________ 6 Other ____

________ 7 Don't Know

43 ________

I) In your area of the city, would you say that odor pollution is . . . ?

________ 1 Not a serious problem at all

________ 2 A more serious problem than it was a year ago

________ 3 A less serious problem than it was a year ago

________ 4 A continuous and serious problem for over a year that has not gotten worse or better

44 ________

Q8) Some people in your area of the city have mentioned that they buy bottled drinking water. Let's suppose that you could also buy clean, odor-free air. How much would you be willing to pay for odor-free air per month?

$________________________________ ________ Don't Know

45 ________

Q9A) Do you own or are you purchasing this home?

________ 1 No (SKIP TO Q10) ________ 2 Yes (ASK FOLLOWING)

________ 3 Don't Know/Refused (SKIP TO Q10)

46 ________

B) Would you tell me approximately what price you paid for your home?

$________________________________

________ Don't Know ________ Refused

47 ________

C) Do you feel that odor pollution has reduced the value of your home in any way, or not?

________ 1 No (SKIP TO Q10) ________ 2 Yes (ASK FOLLOWING)

________ 3 Don't Know (SKIP TO Q10)

48 ________

*D) How has odor pollution reduced the value of your home?

________ 1 Potential buyers are discouraged

________ 2 Guests/family members are uncomfortable

________ 3 Causes deterioration of house

________ 4 Can't use yard

________ 5 Don't go out

________ 6 Other ____

________ 7 Don't Know

49 ________

E) In terms of dollars, how much would you estimate odor pollution has reduced the value of your home?

$________________________

Don't Know/Refused (ASK: In terms of a percentage, could you estimate how much odor pollution has reduced the value of your home?) 50________

________________________% ________Don't Know/Refused 51________

F) If your house was located in an area identical to yours but without the odor pollution, how much more, if anything, do you estimate you would be able to get for your home if you were to sell it?

$________________________ ________Don't Know/Refused 52________

Q10) When houses in your neighborhood go up for sale, about how long does it usually take to sell them?

________1 Less than a week
________2 A week to a month
________3 One to three months
________4 Four to six months
________5 Seven to nine months
________6 Ten to twelve months
________7 More than a year
________8 Don't Know

53________

Q11) If you consider the advantages and disadvantages for the people in your area of the city, do you think it is good or bad to have industries that produce odors near your neighborhood?

________1 Good
________2 Bad
________3 Don't Know
________4 Refused

54________

(IF "GOOD" OR "BAD," ASK: Why is that?)

____ 55________

____

Q12) Have you ever seriously considered moving away from here because of odor pollution?

________1 No ________2 Yes ________3 Don't Know/Refused 56________

Q13) Could you tell me how bad odors in a community might possibly affect the daily activities of the residents, if at all?

____

____ 57________

____

________Don't Know

Q14) Has a strong odor ever forced you or any member of your family to go indoors?

________No 1 ________Yes 2 ________Don't Know/Refused 3 58________

Q15) Do odors in the air ever make you or members of your family physically ill?

________No 1 ________Yes 2 ________Don't Know/Refused 3 59________

(IF "YES," ASK: In what way?)

____ 60________

____

Q16A) Have you ever requested some authority or agency to take action concerning either noise or odor pollution in your area of the city?

________No (SKIP TO Q17) 1 ________Yes (ASK: Which problem?) 2 ________Refused 3 61________

________Noise 1

________Odor pollution (ASK FOLLOWING) 2 62________

*B) What agency or authority did you contact?

________Air pollution control agency 1 ________Health Department 2 63________

________City Hall 3 ________Police Department 4

________Other____ 5

________Don't Know 6

Q17A) Would you be willing to sign a complaint about either noise or odor pollution?

________No 1 ________Yes (ASK: Which problem?) 2 ________Don't Know 3 64________

________Noise 1

________Odor pollution 2 65________

B) Would you be willing to appear in court to voice your complaint?

________No 1 ________Yes 2 ________Don't Know 3 66________

All of the information you've given us today will be kept strictly confidential. The following information is needed to help us classify, analyze, and put data into summary report form. Individual replies will be kept confidential and used only to calculate averages.

Q18) How long have you lived at your present address?

________________years________________months 67________

________Don't Know/Refused

Q19A) What kind of work are you now doing?________________________________

________1 Professional/technical ________2 Manager/official/proprietor

________3 Clerical/sales ________4 Skilled craftsman/foreman

________5 Operative/semi-skilled ________6 Service/non-skilled worker 68________

________7 Armed services ________8 Student

________9 Housewife ________10 Retired/unemployed

________11 Refused

B) (FOR CATEGORIES 1-6, ASK:)

In what kind of business or industry is this done?________________________________

________1 Industry under investigation ________2 Other business 69 ________

________3 Refused

Q20) Would you tell me approximately what age group you are in. Is it . . . ?

________1 18-24 years ________2 25-34 years ________3 35-49 years

________4 50-64 years ________5 65 years or over ________6 Refused 70________

Q21) What is the highest grade of school you've completed?

________1 Eighth grade or less ________2 Some high school

________3 High school graduate ________4 Some college

________5 College graduate ________6 Post graduate 71________

________7 Vocational school ________8 Refused

Q22) How many persons, including yourself, live in this household?

________1 One or two ________2 Three or four

________3 Five or more ________4 Refused 72________

Q23) Considering your total yearly family income, what group would you say you're in? Is it . . . ?

________1 Less than $5,000 ________2 $5,000-$7,999

________3 $8,000-$9,999 ________4 $10,000-$14,999

________5 $15,000 and over ________6 Don't Know 73________

________7 Refused

INTERVIEWER RECORD:

Q24) Sex:

________1 Male ________2 Female 74________

Interviewer's Name:________________________________

APPENDIX C

PUBLIC ATTITUDE SURVEY FINDINGS

Comparison of findings from public attitude surveys conducted in TA(Hawthorne) and CA(Torrance).

Preceding page blank

Q1. "In general, how would you rate your area of the city as a place to live? Would you rate it...?"

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Excellent	26.5%	26.0%	34.7%	34.0%	32.0%	40.0%
Good	60.3	52.0	45.3	32.0	46.7	53.3
Fair	13.2	20.0	16.0	22.0	17.3	4.0
Poor	--	2.0	4.0	4.0	2.7	2.7
Very poor	--	--	--	8.0	--	--
Don't know	--	--	--	--	1.3	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q2. "Can you think of any annoying things in your area that your neighbors complain about?"

Response	December[a]		March		June[b]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	20.6%	44.0%	46.7%	40.0%	33.3%	50.7%
Yes	77.9	56.0	53.3	60.0	66.7	48.0
Don't know	1.5	--	--	--	--	1.3
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

[a] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).
[b] TA(H) and CA(T) are significantly different at the 5% level (X^2 test).

Q2 (Second Part). "What are they?"* (multiple responses).

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Air pollution or odors	58.3%	51.3%	49.9%	24.1%	49.3%	25.0%
Crime or area has deteriorated	2.8	2.9	--	--	--	--
Water pollution	4.2	34.3	4.2	6.1	--	--
Airport, industrial, or traffic noise	22.2	--	22.9	27.3	14.8	22.7
Dirt/litter	--	--	2.1	3.0	4.9	6.8
Drain/sewerage	1.4	2.9	--	--	--	2.3
Traffic	--	--	2.1	6.1	1.6	13.6
Refineries in area	--	--	--	27.3	--	4.5
Freeway in neighborhood	2.8	--	2.1	--	9.8	--
Public transportation	--	--	--	--	--	--
Schools	--	--	--	--	1.6	--
Drugs	--	--	--	--	--	--
High taxes	--	--	--	--	1.6	--
Other	8.3	8.6	16.7	6.1	16.4	25.1
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	72	35	48	33	61	44
Total no. of respondents	53	28	40	30	50	36

* Asked of the respondents who answered "Yes" to the previous question.

Q3A. "Here are a few problems which different community areas are facing. How would you rate each of these for your area of the city in terms of being serious, somewhat serious, or not serious?"

Response	December		March[a]		June[b]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Water pollution:						
Serious	7.4%	28.0%	21.3%	20.0%	5.3%	25.3%
Somewhat serious	8.8	16.0	17.3	16.0	22.7	10.7
Not serious	80.9	42.0	56.0	46.0	60.0	53.3
Don't know	2.9	14.0	5.4	18.0	12.0	10.7
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75
Noise in the community:						
Serious	5.9%	18.0%	22.7%	20.0%	20.0%	13.3%
Somewhat serious	20.6	24.0	12.0	16.0	28.0	36.0
Not serious	73.5	58.0	64.0	64.0	52.0	50.7
Don't know	--	--	1.3	--	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75
Crime:						
Serious	2.9%	14.0%	9.3%	14.0%	13.3%	22.7%
Somewhat serious	22.1	26.0	10.7	18.0	26.7	16.0
Not serious	61.8	54.0	76.0	68.0	57.3	52.0
Don't know	13.2	6.0	4.0	--	2.7	9.3
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q3A (Continued).

Response	December TA(H)	December CA(T)	March[a] TA(H)	March[a] CA(T)	June[b] TA(H)	June[b] CA(T)
Deterioration of streets, parks, utilities, public buildings, etc.:						
Serious	1.5%	6.0%	2.7%	2.0%	2.7%	2.7%
Somewhat serious	1.5	8.0	8.0	6.0	4.0	12.0
Not serious	94.1	86.0	89.3	90.0	92.0	85.3
Don't know	2.9	--	--	2.0	1.3	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75
Air pollution:						
Serious	38.2%	26.0%	49.3%	44.0%	48.0%	30.7%
Somewhat serious	36.8	40.0	36.0	18.0	34.7	30.7
Not serious	25.0	32.0	14.7	38.0	17.3	38.6
Don't know	--	2.0	--	--	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75
Deterioration of stores, homes, industrial buildings, etc.:						
Serious	1.5%	2.0%	5.3%	10.0%	2.7%	1.3%
Somewhat serious	13.2	8.0	14.7	2.0	4.0	10.7
Not serious	79.4	90.0	80.0	88.0	93.3	85.3
Don't know	5.9	--	--	--	--	2.7
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q3A (Continued).

---

[a] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).
[b] TA(H) and CA(T) are significantly different at the 5% level (X^2 test).

Q4A. "Are there any conditions in your neighborhood that would cause you to spend your leisure time inside your home rather than outside in the yard, neighborhood parks, etc.?"

Response	December		March		June[a]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	69.1%	72.0%	74.7%	88.0%	64.0%	80.0%
Yes	30.9	28.0	25.3	8.0	34.7	18.7
Don't know	--	--	--	4.0	1.3	1.3
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

[a] TA(H) and CA(T) are significantly different at the 5% level (X^2 test).

Q4A (Second Part). "What are they?"* (multiple responses).

Response	December		March		June[a]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Odors	61.7%	37.4%	50.0%	38.4%	54.9%	21.4%
Noise	7.7	12.5	15.0	7.7	3.2	7.1
Cold weather or wind	15.4	31.3	15.0	23.1	16.1	57.3
Smog	3.8	6.3	--	--	6.5	7.1
Smoke	3.8	--	--	--	--	--
Haze	3.8	--	--	--	--	7.1
Hard to breathe	--	--	--	--	--	--
Irritation of the eyes	--	--	--	7.7	3.2	--
Irritation of the nose	--	--	--	--	3.2	--
Irritation of the throat	--	--	--	--	3.2	--
Headaches	--	--	--	--	--	--
Area unsafe	--	--	--	23.1	6.5	--
Other	3.8	12.5	20.0	--	3.2	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	26	16	20	13	31	14
Total no. of respondents	22	10	19	12	26	14

* Asked of the respondents who answered "Yes" to the previous question.

[a] TA(H) and CA(T) are significantly different at the 10% level (X^2 test).

Q4B. "Are there any conditions in your neighborhood that would cause you to spend your leisure time away from your home?"

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	89.7%	88.0%	90.7%	98.0%	90.7%	89.3%
Yes	10.3	10.0	9.3	2.0	9.3	10.7
Don't know	--	2.0	--	--	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q4B (Second Part). "What are they?"* (multiple responses).

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Odors	66.7%	57.1%	75.0%	100.0%	100.0%	-- %
Noise	11.1	42.9	12.5	--	--	--
Cold weather or wind	11.1	--	--	--	--	--
Smog	--	--	--	--	--	--
Smoke	--	--	--	--	--	--
Haze	--	--	--	--	--	--
Hard to breathe	--	--	--	--	--	--
Irritation of the eyes	--	--	--	--	--	--
Irritation of the nose	--	--	--	--	--	--
Irritation of the throat	--	--	--	--	--	--
Headaches	--	--	--	--	--	--
Area unsafe	--	--	--	--	--	--
Other	11.1	--	12.5	--	--	100.0
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	9	7	8	1	7	8
Total no. of respondents	7	5	7	1	7	8

* Asked of the respondents who answered "Yes" to the previous question.

Q5A. "What do the words 'air pollution' mean to you? Please answer 'Yes' or 'No' to the following. Do they mean...?"

	December		March		June	
Response	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Smoke:						
Yes	52.9%	70.0%	62.7%	84.0%	62.7%	69.3%
No	22.1	26.0	37.3	16.0	37.3	29.3
Don't know	25.0	4.0	--	--	--	1.4
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75
Dust:						
Yes	33.8%	56.0%	62.7%	72.0%	49.3%	62.7%
No	36.8	42.0	37.3	28.0	49.3	36.0
Don't know	29.4	2.0	--	--	1.4	1.3
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75
Haze:						
Yes	32.4%	58.0%	69.3%	72.0%	73.3%	49.3%
No	42.7	40.0	30.7	22.0	24.0	48.0
Don't know	24.9	2.0	--	6.0	2.7	2.7
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q5A (Continued).

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Fog:						
Yes	11.8%	12.0%	22.7%	30.0%	4.0%	12.0%
No	57.4	86.0	76.0	70.0	93.3	88.0
Don't know	30.8	2.0	1.3	--	2.7	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75
Noticeable odors:						
Yes	79.4%	82.0%	92.0%	90.0%	97.3%	97.3%
No	8.8	16.0	8.0	8.0	2.7	2.7
Don't know	11.8	2.0	--	2.0	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75
Irritation of the eyes:						
Yes	72.1%	90.0%	100.0%	96.0%	100.0	98.7%
No	20.6	8.0	--	2.0	--	1.3
Don't know	7.3	2.0	--	2.0	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q5A (Continued).

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Irritation of the nose or throat:						
Yes	69.1%	84.0%	97.3%	92.0%	98.7%	96.0%
No	23.5	14.0	2.7	4.0	1.3	4.0
Don't know	7.4	2.0	--	4.0	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q5B. "Are any of these a problem in your area of the city?"

Response	December		March[a]		June[b]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	16.2%	24.0%	17.3%	30.0%	17.3%	46.7%
Yes	82.4	76.0	82.7	66.0	81.3	53.3
Don't know	1.4	--	--	4.0	1.4	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

[a] TA(H) and CA(T) are significantly different at the 10% level (X^2 test).

[b] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).

Q5B (Second Part). "Which one is the worst?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Smoke	3.6%	5.3%	4.8%	6.1%	--	2.5%
Dust	--	7.9	1.6	9.1	1.6	2.5
Haze	3.6	7.9	6.5	3.0	3.2	--
Fog	1.8	10.5	--	18.2	1.6	20.0
Noticeable odors	57.1	39.4	62.9	33.3	65.6	47.5
Irritation of the eyes	10.7	21.1	16.1	30.3	23.0	22.5
Irritation of the nose or throat	23.2	7.9	8.1	--	5.0	5.0
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	56	38	62	33	61	40
Total no. of respondents	56	38	62	33	61	40

* Asked of the respondents who answered "Yes" to the previous question.

Q6A. "Some people here in ___(name of city)___ have been complaining recently about noise. Have you noticed noise in your neighborhood during the last three months?"

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	69.1%	60.0%	64.0%	60.0%	56.0%	64.0%
Yes	30.9%	40.0%	36.0%	40.0%	44.0%	36.0%
Don't know	--	--	--	--	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q6B. "Would you say that noise has bothered you?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	9.5%	15.0%	22.2%	5.0%	42.4%	33.3%
Yes	90.5	85.0	77.8	95.0	57.6	66.7
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	21	20	27	20	33	27
Total no. of respondents	21	20	27	20	33	27

* Asked of the respondents who answered "Yes" to Q6A.

Q6B (Second Part). "How much would you say it has bothered you? Is it...?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Very much	21.1%	52.9%	42.8%	52.6%	52.6%	27.8%
Much	21.1	5.9	14.3	15.8	21.1	11.1
Moderately	36.7	35.3	23.8	15.8	10.5	33.3
Little	15.8	5.9	--	15.8	10.5	22.2
Very little	5.3	--	19.1	--	5.3	5.6
Don't know	--	--	--	--	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	19	17	21	19	19	18
Total no. of respondents	19	17	21	19	19	18

* Asked of the respondents who answered "Yes" to the previous question.

Q6C. "How often has noise bothered you? Is it...?"*

Response	December TA(H)	December CA(T)	March TA(H)	March CA(T)	June TA(H)	June CA(T)
Very often	15.8%	35.3%	19.1%	26.3%	57.8%	16.7%
Often	26.3	17.6	38.0	31.6	15.8	16.7
About half the time	15.8	11.8	19.1	15.8	15.8	33.2
Infrequently	26.3	29.4	14.3	26.3	5.3	27.8
Very infrequently	10.5	5.9	9.5	--	5.3	5.6
Don't know	5.3	--	--	--	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	19	17	21	19	19	18
Total no. of respondents	19	17	21	19	19	18

* Asked of the respondents who answered "Yes" to Q6B.

Q6D. "Could you tell me where most of this noise comes from, that is, who or what causes it?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Airplanes	33.3%	5.0%	40.7%	15.0%	30.3%	14.8%
Plant being investigated	--	--	--	--	--	--
Other factory	--	35.0	--	35.0	--	14.8
Traffic	57.1	45.0	40.8	35.0	45.5	55.6
Construction	--	--	--	5.0	--	3.7
Animals	--	--	--	--	--	--
Trains	--	--	3.7	--	3.0	--
Motorcycles	--	--	14.8	--	18.2	7.4
Other	4.8	15.0	--	5.0	3.0	3.7
Don't know	4.8	--	--	5.0	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	21	20	27	20	33	27
Total no. of respondents	21	20	27	20	33	27

Q6E. "In your area of the city, would you say that noise is . . . ?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Not a serious problem at all	19.0%	25.0%	18.5%	20.0%	21.2%	22.2%
A more serious problem that it was a year ago	52.4	40.0	48.2	65.0	54.6	48.2
A less serious problem than it was a year ago	--	--	--	5.0	--	7.4
A continuous and serious problem for over a year that has not gotten worse or better	28.6	35.0	33.3	10.0	24.2	22.2
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	21	20	27	20	33	27
Total no. of respondents	21	20	27	20	33	27

* Asked of the respondents who answered "Yes" to Q6A.

Q7A. "Some people have also complained about odor pollution. Have you noticed any odors in your neighborhood in the last three months?"

Response	December		March[a]		June[b]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	29.4%	36.0%	21.3%	46.0%	21.3%	57.3%
Yes	70.6	64.0	78.7	54.0	78.7	42.7
Don't know	--	--	--	--	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

[a] TA(H) and CA(T) are significantly different at the 5% level (X^2 test).

[b] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).

Q7B. "Have you noticed odors most during the morning, the afternoon, the evening, or any other particular time?"* (multiple responses).

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
During the morning	1.7%	33.2%	11.9%	15.1%	5.8%	44.4%
During the afternoon	25.3	2.8	40.5	9.0	33.3	2.8
During the evening	15.3	22.2	28.6	24.2	23.2	33.3
When the air is still	5.1	--	--	--	--	--
When the plant ________	5.1	--	1.2	--	--	--
All/most of the time	5.1	--	--	3.0	1.4	--
No particular time	6.8	5.6	4.8	3.0	14.5	2.8
When the wind blows from the W	18.6	2.8	6.0	3.0	13.0	--
When the wind blows from the N, NW	1.7	2.8	--	--	--	--
When the wind blows from the S, SW	--	--	--	3.0	--	--
When the wind blows from the E	1.7	22.2	1.2	33.3	1.4	13.9
Weekends	1.7	2.8	--	--	2.9	--
Warm weather	1.7	--	--	--	--	--
Other	5.1	5.6	1.2	3.0	--	--
Don't know	5.1	--	4.6	3.4	4.5	2.8
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	59	36	84	33	69	36
Total no. of respondents	48	32	84	33	59	32

* Asked of the respondents who answered "Yes" to Q7A.

Q7C. "How often have you noticed these odors? Is it...?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Everyday	12.5%	-- %	6.8%	11.1%	1.7%	-- %
At least once a week	35.4	50.0	35.6	29.6	35.6	21.9
At least once a month	18.8	25.0	32.2	29.6	23.7	31.3
Only occasionally	25.0	25.0	23.7	7.4	37.3	43.8
Don't know	8.3	--	1.7	22.3	1.7	3.0
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	48	32	59	27	59	32
Total no. of respondents	48	32	59	27	59	32

*Asked of the respondents who answered "Yes" to Q7A.

Q7D. "Generally speaking, how long do these odors last?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
All the time	4.2%	-- %	-- %	-- %	1.7%	-- %
Two or three days	4.2	6.3	6.8	7.4	1.7	3.1
One day	10.4	18.8	13.6	25.9	10.2	15.6
More than one hour, but less than one day	54.2	62.5	64.4	55.6	71.2	68.8
One hour or less	6.3	6.3	6.8	3.7	8.5	6.3
As long as the wind blows	6.3	--	--	--	--	--
As long as the weather is right	2.1	--	--	3.7	--	--
Other	6.3	--	--	--	--	--
Don't know	6.0	6.1	8.4	3.7	6.7	6.2
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	48	32	59	27	59	32
Total no. of respondents	48	32	59	27	59	32

* Asked of the respondents who answered "Yes" to Q7A.

Q7E. "Would you say that these odors have bothered you?"*

Response	December		March[a]		June[b]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	8.3%	15.6%	22.0%	3.7%	5.1%	28.1%
Yes	91.7	84.4	78.0	96.3	94.9	71.9
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	48	32	59	27	59	32
Total no. of respondents	48	32	59	27	59	32

* Asked of the respondents who answered "Yes" to Q7A.

[a] TA(H) and CA(T) are significantly different at the 5% level (X^2 test).

[b] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).

Q7E (Second Part). "How much would you say they have bothered you? Is it...?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Very much	43.1%	22.2%	56.5%	46.1%	46.4%	47.8%
Much	18.2	7.4	15.2	19.2	19.6	13.0
Moderately	36.4	48.2	23.9	30.8	25.0	34.8
Little	2.3	3.7	4.4	3.9	3.6	4.4
Very little	--	18.5	--	--	5.4	--
Don't know	--	--	--	--	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	44	27	46	26	56	23
Total no. of respondents	44	27	46	26	56	23

* Asked of the respondents who answered "Yes" to the previous question.

Q7F. "How often have these odors bothered you? Is it...?"*

Response	December		March		June[a]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Very often	27.3%	18.5%	37.0%	15.4%	41.0%	30.4%
Often	25.0	25.9	39.1	46.2	25.0	13.0
About half the time	11.4	18.5	8.7	15.4	16.1	21.8
Infrequently	29.5	25.9	10.9	15.4	12.5	34.8
Very infrequently	4.5	11.2	2.2	--	5.4	--
Don't know	2.3	--	2.1	7.6	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	44	27	46	26	56	23
Total no. of respondents	44	27	46	26	56	23

* Asked of the respondents who answered "Yes" to Q7E.

[a] TA(H) and CA(T) are significantly different at the 5% level (X^2 test).

Q7G. "What bothers you most about these odors? Would you say that it is...?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
The number of times that you notice odors	11.4%	3.7%	4.4%	3.9%	1.8%	4.4%
The strength of the odors in the air	77.3	88.9	78.2	92.2	89.3	95.6
The length of time that the odors last	6.8	7.4	17.4	3.9	7.1	--
Don't know	4.5	--	--	--	1.8	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	44	27	46	26	56	23
Total no. of respondents	44	27	46	26	56	23

* Asked of the respondents who answered "Yes" to Q7E.

Q7H. "Could you tell me where most of these odors originate, that is, who or what causes them?"*

Response	December[a]		March[a]		June[a]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Plant being investigated	89.6%	-- %	79.7%	-- %	67.8%	3.1%
Other factory	--	81.3	3.4	85.2	1.7	59.4
Swamp/bay/river	--	--	--	--	--	--
Dump/incinerator/sewerage treatment	--	--	--	--	3.4	--
Motor vehicle exhaust	--	3.1	--	3.7	--	--
Other	4.2	--	--	--	1.7	--
Don't know	6.2	15.6	16.9	11.1	25.4	37.5
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	48	32	59	27	59	32
Total no. of respondents	48	32	59	27	59	32

* Asked of the respondents who answered "Yes" to Q7A.

[a] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).

Q7I. "In your area of the city, would you say that odor pollution is . . . ?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Not a serious problem	6.3%	31.3%	13.6%	7.4%	15.3%	25.0%
A more serious problem than it was a year ago	54.1	37.4	30.5	55.6	17.0	18.8
A less serious problem than it was a year ago	4.2	--	8.5	3.7	18.6	3.1
A continuous and serious problem for over a year that has not gotten worse or better	35.4	31.3	47.4	33.3	49.1	53.1
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	48	32	59	27	59	32
Total no. of respondents	48	32	59	27	59	32

* Asked of the respondents who answered "Yes" to Q7A.

Q8. "Some people in your area of the city have mentioned that they buy bottled drinking water. Let's suppose that you could also buy clean, odor-free air. How much would you be willing to pay for odor-free air per month?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
$1 - $4	12.5%	3.1%	3.4%	-- %	-- %	3.1%
$5 - $8	4.2	9.4	3.4	--	3.4	--
$9 - $12	4.2	6.3	--	--	1.7	--
$13 - $19	--	--	--	--	--	--
$20 or more	4.2	3.1	5.1	--	1.7	--
Whatever it would cost	2.1	3.1	--	--	1.7	3.1
Nothing	4.2	6.3	6.8	--	10.2	--
Don't know	68.6	68.7	81.3	100.0	81.3	93.8
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	48	32	59	27	59	32
Total no. of respondents	48	32	59	27	59	32

* Asked of the respondents who answered "Yes" to Q7A.

Q9A. "Do you own or are you purchasing this home?"

Response	December TA(H)	December CA(T)	March TA(H)	March CA(T)	June TA(H)	June CA(T)
No	5.9%	6.0%	8.0%	8.0%	4.0%	8.0%
Yes	92.7	94.0	92.0	92.0	96.0	92.0
Don't know/refused	1.4	--	--	--	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q9B. "Would you tell me approximately what price you paid for your home?"*

Response	December TA(H)	December CA(T)	March TA(H)	March CA(T)	June TA(H)	June CA(T)
Less than $5,000	-- %	-- %	-- %	-- %	-- %	-- %
$5,000 - $9,999	--	--	1.5	2.2	--	--
$10,000 - $14,999	6.3	25.5	17.4	15.2	13.9	33.3
$15,000 - $19,999	11.1	12.8	17.4	15.2	4.2	24.6
$20,000 - $24,999	15.9	23.4	18.8	13.0	15.3	15.9
$25,000 - $29,999	17.5	17.0	20.3	21.7	22.2	7.3
$30,000 - $34,999	14.3	2.1	1.5	2.2	11.1	4.4
$35,000 - $39,999	11.1	2.1	2.9	2.2	4.2	--
$40,000 - $44,999	--	4.3	--	--	--	--
$45,000 or more	1.6	2.1	--	--	--	1.5
Refused	20.6	6.4	14.5	17.4	23.6	10.1
Don't know	1.6	4.3	5.7	10.9	5.5	2.9
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	63	47	69	46	72	69
Total no. of respondents	63	47	69	46	72	69

* Asked of the respondents who answered "Yes" to Q9A.

Q9C. "Do you feel that odor pollution has reduced the value of your home in any way, or not?"*

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	79.4%	89.3%	88.4%	91.3%	84.7%	94.2%
Yes	14.3	6.4	8.7	2.2	8.3	4.4
Don't know	6.3	4.3	2.9	6.5	7.0	1.4
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	63	47	69	46	72	69
Total no. of respondents	63	47	69	46	72	69

* Asked of the respondents who answered "Yes" to Q9A.

Q9D. "How has odor pollution reduced the value of your home?"* (multiple responses).

* Asked of the respondents who answered "Yes" to Q9C. Since so few respondents were asked this question, statistical comparisons could not be made.

Q9E. "In terms of dollars, how much would you estimate odor pollution has reduced the value of your home?"*

* Asked of the respondents who answered "Yes" to Q9C. Since so few respondents were asked this question, statistical comparisons could not be made.

Q9E (Second Part). "In terms of a percentage, could you estimate how much odor pollution has reduced the value of your home?"*

* Asked of the respondents who answered "Don't know/refused" to the previous question. Since so few respondents were asked this question, statistical comparisons could not be made.

Q9F. "If your house was located in an area identical to yours but without the odor pollution, how much more, if anything, do you estimate you would be able to get for your home if you were to sell it?"*

* Asked of the respondents who answered "Yes" to Q9C. Since so few respondents were asked this question, statistical comparisons could not be made.

Q10. "When houses in your neighborhood go up for sale, about how long does it usually take to sell them?"

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Less than a week	2.9%	4.0%	4.0%	16.0%	5.3%	2.7%
A week to a month	33.8	32.0	49.3	38.0	56.0	56.0
One to three months	23.5	34.0	20.0	18.0	25.3	18.7
Four to six months	2.9	8.0	--	--	1.3	--
Seven to nine months	1.5	--	--	2.0	--	1.3
Ten to twelve months	--	--	--	--	--	--
More than a year	--	--	--	--	--	--
Don't know	35.4	22.0	26.7	26.0	12.1	21.3
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q11. "If you consider the advantages and disadvantages for the people in your area of the city, do you think it is good or bad to have industries that produce odors near your neighborhood?"

Response	December		March[a]		June[a]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Good	5.9%	2.0%	8.0%	30.0%	1.3%	13.3%
Bad	57.4	90.0	76.0	68.0	78.7	76.0
Don't know	33.8	8.0	16.0	2.0	20.0	9.3
Refused	2.9	--	--	--	--	1.4
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

[a] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).

Q11 (Second Part). Why is that?"* (multiple responses).

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Employment important/gives people jobs	2.3%	3.6%	1.1%	5.6%	2.0%	2.5%
Industry needed	2.3	1.8	9.9	14.8	--	5.0
Homes increase in value	2.3	--	1.1	--	--	2.5
Contributes to pollution/smog	16.3	34.5	16.5	22.2	9.5	19.8
Bad for general health of people	4.7	36.4	13.2	3.7	18.8	12.5
Hard to breathe	--	1.8	5.5	1.9	5.7	--
Annoying, objectionable	--	--	9.9	1.9	12.4	7.5
Unpleasant	11.6	3.6	6.6	5.6	5.7	8.8
Uncomfortable	4.7	1.8	5.5	5.6	9.5	3.8
Don't like to smell bad odors/want clean air	7.0	--	6.6	25.9	6.7	13.8
Should be separate from residential area/ need better zoning	--	3.6	5.5	11.1	12.4	--
Increases traffic	--	--	2.2	--	1.0	2.5
People move away	4.7	--	--	--	1.0	1.3
Have to close up house/windows/gets into house	--	3.6	1.1	--	1.0	--
Have to stay indoors	2.3	--	2.2	--	7.6	--
Makes homes harder to sell	--	--	2.2	--	--	5.0
Decreases property values	2.3	1.8	3.3	--	5.7	10.0
Other	39.5	7.5	7.6	1.7	1.0	5.0
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	43	55	91	54	105	80
Total no. of respondents	25	42	63	49	59	67

* Asked of the respondents who answered "Good" or "Bad" to the previous question.

Q12. "Have you ever seriously considered moving away from here because of odor pollution?"

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	77.9%	80.0%	78.7%	66.0%	73.3%	86.7%
Yes	16.2	16.0	18.7	28.0	22.7	13.3
Don't know/refused	5.9	4.0	2.6	6.0	4.0	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q13. Could you tell me how bad odors in a community might possibly affect the daily activities of the residents, if at all?" (multiple responses).

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Makes people stay indoors/don't use yard	6.9%	32.7%	29.2%	2.0%	34.9%	41.0%
People leave area for recreational activities	--	--	2.2	--	1.7	--
Causes headaches	2.8	--	--	--	0.9	--
Causes nausea	--	--	1.1	--	2.6	--
Affects breathing	--	5.5	3.3	4.0	3.4	2.4
Eye irritation/nose irritation/throat irritation	--	--	1.1	--	4.3	--
Slows people down	--	--	1.1	--	4.3	2.4
Feel uncomfortable	--	--	2.2	--	7.7	--
Affects general health	1.4	9.1	6.5	--	10.3	4.8
Coughing/choking feeling	--	--	1.1	--	1.7	--
Causes allergies/makes them worse	--	1.8	2.2	--	0.9	--
Puts people in bad mood/makes you irritable	4.2	--	3.3	--	3.4	1.2
Gets into house/have to close up house	2.8	1.8	6.5	--	8.5	2.4
People move away	--	--	5.4	--	--	4.8
Wouldn't affect activities	12.5	18.2	17.4	2.0	9.4	16.9
There is none in this area	1.4	--	--	2.0	--	--
Other	2.8	1.8	2.2	--	--	--
Don't know	65.2	29.1	15.2	90.0	6.0	24.1
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	72	55	92	50	117	83
Total no. of respondents	68	50	75	50	75	75

Q14. "Has a strong odor ever forced you or any member of your family to go indoors?"

Response	December		March		June[a]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	51.5%	64.0%	54.7%	58.0%	45.3%	74.7%
Yes	41.2	32.0	45.3	40.0	54.7	25.3
Don't know/refused	7.3	4.0	--	2.0	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

[a] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).

Q15. "Do odors in the air ever make you or members of your family physically ill?"

Response	December		March		June[a]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	77.9%	74.0%	70.7%	80.0%	72.0%	88.0%
Yes	19.1	22.0	28.0	20.0	28.0	12.0
Don't know/refused	3.0	4.0	1.3	--	--	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

[a] TA(H) and CA(T) are significantly different at the 5% level (X^2 test).

Q15 (Second Part). "In what way?"* (multiple responses).

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Nausea	33.2%	26.7%	31.1%	33.3%	28.6%	60.0%
Headaches	6.7	33.2	19.2	8.3	14.3	10.0
Eye irritation	13.3	6.7	11.5	--	3.6	--
Nose irritation	--	6.7	3.8	16.7	--	10.0
Throat irritation	13.3	--	3.8	--	7.1	--
Coughing/choking feeling	6.7	--	3.8	--	10.7	--
Causes allergies/makes them worse	6.7	6.7	7.7	16.7	7.1	--
Makes breathing difficult	6.7	20.0	11.5	16.7	25.0	20.0
Affects general health	6.7	--	3.8	8.3	--	--
Other	6.7	--	3.8	--	3.6	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	15	15	26	12	28	10
Total no. of respondents	13	11	21	10	21	9

* Asked of the respondents who answered "Yes" to the previous question.

Q16A. "Have you ever requested some authority or agency to take action concerning either noise or odor pollution in your area of the city?"

Response	December[a]		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	69.1%	88.0%	74.7%	84.0%	80.0%	81.3%
Yes	30.9	10.0	25.3	14.0	18.7	18.7
Refused	--	2.0	--	2.0	1.3	--
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

[a] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).

Q16A (Second Part). "Which problem?"*

Response	December		March[a]		June[b]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Noise	9.5%	60.0%	5.3%	28.6%	14.3%	50.0%
Odor pollution	90.5	40.0	94.7	71.4	85.7	50.0
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	21	5	19	7	14	14
Total no. of respondents	21	5	19	7	14	14

* Asked of the respondents who answered "Yes" to the previous question.

[a] TA(H) and CA(T) are significantly different at the 10% level (X^2 test).

[b] TA(H) and CA(T) are significantly different at the 5% level (X^2 test).

Q16B. "What agency or authority did you contact?"* (multiple responses).

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Air pollution control agency	30.4%	-- %	42.1%	71.4%	35.7%	25.0%
Health Department	8.9	16.7	--	--	--	--
City Hall	8.9	33.3	5.3	28.6	--	18.8
Police Department	8.9	16.7	15.8	--	14.3	31.3
Citizens' groups	8.9	--	10.5	--	7.1	--
Neighborhood meetings	21.7	--	--	--	21.4	--
City government	4.3	--	--	--	--	--
State government	--	--	5.3	--	--	6.3
Federal government	--	--	5.3	--	--	--
Other	4.3	--	--	--	7.1	12.3
Don't know	3.7	33.3	15.7	--	14.4	6.3
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	23	6	19	7	14	16
Total no. of respondents	21	5	19	7	14	14

* Asked of the respondents who answered "Yes" to Q16A.

Q17A. "Would you be willing to sign a complaint about either noise or odor pollution?"

Response	December		March		June	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	30.9%	20.0%	29.3%	38.0%	16.0%	10.7%
Yes	41.2	58.0	57.3	62.0	58.7	84.0
Don't know	27.9	22.0	13.4	--	25.3	5.3
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

Q17A (Second Part). "Which problem?"* (multiple responses).

Response	December[a]		March		June[b]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
Noise	10.0%	38.1%	16.3%	15.2%	13.6%	34.9%
Odor pollution	90.0	61.9	83.7	84.8	86.4	65.1
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	30	42	43	33	44	63
Total no. of respondents	28	29	43	31	44	63

* Asked of the respondents who answered "Yes" to the previous question.

[a] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).

[b] TA(H) and CA(T) are significantly different at the 5% level (X^2 test).

Q17B. "Would you be willing to appear in court to voice your complaint?"

Response	December[a]		March[a]		June[b]	
	TA(H)	CA(T)	TA(H)	CA(T)	TA(H)	CA(T)
No	30.9%	22.0%	38.7%	66.0%	26.7%	9.3%
Yes	26.5	44.0	44.0	30.0	38.7	80.0
Don't know	42.6	34.0	17.3	4.0	34.6	10.7
All responses	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total no. of responses	68	50	75	50	75	75
Total no. of respondents	68	50	75	50	75	75

[a] TA(H) and CA(T) are significantly different at the 10% level (X^2 test).

[b] TA(H) and CA(T) are significantly different at the 1% level (X^2 test).

APPENDIX D

TECHNICAL FIELD STUDIES DATA

Summary of percentage of time odor was detected and mean odor intensity at panelist locations in TA(Hawthorne), TA(X Hawthorne), and TA(El Segundo).

Map of panelist locations in TA(Hawthorne) and TA(El Segundo).

ODOR INTENSITY RATING SUMMARY SHEET

Figure D-1. Summary of December ratings in TA(Hawthorne).

Panelist Location (Station)	Percent Time Detected and Mean Odor Intensity																			
	Date:11/30/70				Date:12/1/70				Date:12/2/70				Date:12/3/70				Date:12/4/70			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M
142nd & Judah		PANELIST SCREENING AND TRAINING, NO FIELD ACTIVITIES				PANELIST SCREENING AND TRAINING, NO FIELD ACTIVITIES			36	.4	21	.1			39	.3		PANELISTS USED IN DEVELOPING ODOR PANEL/SCENTOMETER CORRELATIONS		
141st & Glasgow									26	.3	9	.1			0	0				
141st & Isis									26	.1	44	.5			0	0				
140th & Judah															9	.1				
139th & Glasgow									30	.3	40	.4			0	0				
139th & Isis									13	.1	41	.4			2	0				
139th & Judah									15	.2	11	.1								
138th & Judah									61	.7	32	.3			20	2				
137th & Glasgow									7	.1	46	.5			19	.2				
137th & Isis									55	.7	28	.5			20	2				
135th & Glasgow									19	.2	54	.6			26	.3				
135th & Isis									20	.3	68	1.0			2	0				
135th & Judah									100	1.4	45	.9			8	.1				
134th & Glasgow									55	.6	79	1.3			56	.6				
134th & Isis									47	.7	100	1.5			20	.2				
Wiseburn & Hindry									18	.2	23	.2			0	0				
Wiseburn & Judah									29	.3	50	.6			14	.1				

ODOR INTENSITY RATING SUMMARY SHEET

Figure D-2. Summary of December ratings in TA(X Hawthorne).

Panelist Location (Station)	Percent Time Detected and Mean Odor Intensity																			
	Date:11/30/70				Date:12/1/70				Date:12/2/70				Date:12/3/70				Date:12/4/7			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M
Imperial & Judah		PANELIST SCREENING AND TRAINING, NO FIELD ACTIVITIES				PANELIST SCREENING AND TRAINING, NO FIELD ACTIVITIES			25	.3	0	0		PANELISTS USED IN DEVELOPING ODOR PANEL/SCENTOMETER CORRELATIONS				PANELISTS USED IN DEVELOPING ODOR PANEL/SCENTOMETER CORRELATIONS		
Imperial & Isis									0	0	0	0								
Imperial & La Cienega									100	1.3	0	0								
117th & Judah									7	.1	4	0								
117th & Isis									64	1.2	7	.1								
117th & La Cienega									0	0	0	0								
119th & Judah									0	0	0	0								
119th & Isis									24	.2	4	0								
119th & La Cienega									0	0	0	0								
122nd & Judah									43	.4	0	0								
122nd & Hindry									32	.6	0	0								
124th & Judah									75	.9	9	.1								
124th & Isis									17	.2	0	0								
124th & Glasgow									18	.2	0	0								
126th & Isis									8	.1	0	0								
126th & Glasgow									25	.2	3	0								

ODOR INTENSITY RATING SUMMARY SHEET

Figure D-3. Summary of March ratings in TA(Hawthorne).

Panelist Location (Station)	Percent Time Detected and Mean Odor Intensity																			
	Date:3/15/71				Date:3/16/71				Date:3/17/71				Date:3/18/71				Date:3/19/71			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M
142nd & Judah		PANELIST SCREENING AND TRAINING, NO FIELD ACTIVITIES			20	.1	0	0	5	0	12	.1	60	.8	35	.3	16	.1	61	.5
141st & Isis					5	.1	48	.3	54	.3	13	.1	7	0	0	0	40	.3	22	.1
140th & Judah					16	.1	27	.3	32	2	0	0	33	.4	23	.2	46	.6	65	.8
138th & Judah					32	.2	65	.4	11	.1	9	.1	49	.4	17	.1	19	.1	67	1.1
138th & Isis					98	1.1	16	.1	44	.4	0	0	42	.3	30	.4	32	.3	11	.1
138th & Glasgow					38	.3			19	.1			87	.5	27	.2	11	.1	42	.3
137th & Isis					47	.4	5	0			15	.1	41	.3	0	0	62	.4	63	.4
135th & Judah					19	.1	0	0			0	0	21	.1	12	.1	56	.4	60	.3
135th & Isis							22	.2			0	0	6	.1	23	.2	10	.1	23	.2
135th & Glasgow					60	.8	62	.7	16	.1	23	.2	58	.5	39	.2	28	.2	0	0
134th & Judah									7	.1	58	.6	25	.2	11	.1	16	.1	90	.7
134th & Isis					3	0	21	.2	0	0	2	0	6	0	94	.95	2	0	4	0
134th & Glasgow					27	.2	40	.3	0	0	0	0	13	.1	11	.1	48	.3	23	.1
Wiseburn & Judah					100	1.1	57	.6												
Wiseburn & Hansworth					28	.1	39	.4	61	.5	28	.1	41	.3	11	.1	86	1.2	23	.2
132nd & Hindry					12	.1	25	.2	0	0	0	0	0	0	16	.1	20	.1	0	0

ODOR INTENSITY RATING SUMMARY SHEET

Figure D-4. Summary of March ratings in TA(El Segundo).

Panelist Location (Station)	Percent Time Detected and Mean Odor Intensity																			
	Date:3/15/71				Date:3/16/71				Date:3/17/71				Date:3/18/71				Date:3/19/7			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M
Whiting & Franklin		PANELIST SCREENING AND TRAINING, NO FIELD ACTIVITIES			2	0	39	.4	14	.1	0	0	14	.2	6	.1	3	0	0	0
Virginia & Holly					0	0	0	0	17	.2	5	.1	8	.1	0	0	0	0	20	.1
Richmond & Franklin					0	0	43	.4	15	.2	26	.2	16	.1	3	0	20	.2	3	0
Richmond & Pine					0	0	0	0	15	.2	0	0	0	0	0	0	0	0		
Eucalyptus & El Segundo					14	.1	95	1.1	100	1.4	60	.7	17	.1	86	1.3	26	.2	40	.5
Eucalyptus & Holly					0	0	0	0	51	.8	0	0	6	.1	7	0	1	0	8	.1
Penn & El Segundo					5	0	96	.8	69	.7	75	1.1	20	.2			0	0	27	.2
Sierra & Holly					0	0									0	0	5	.1	26	.1
Lomita & Franklin					23	.1	100	1.0	59	.5	81	1.4	20	.3	88	1.2	6	0	14	.1
Maryland & Grand					19	.2	8	.1	29	.2	50	.5	12	.1	27	.2	43	.3	8	0
Holly & Bungalow					14	.1	15	.1	34	.4	58	.9	15	.1	13	.1	6	0	3	0
Center & Franklin					20	.1	36	.2	27	.2	57	.5	13	.1	54	.4	3	0	15	.1
Oregon & Franklin					69	.7	9	0	35	.2	23	.2	15	.2	17	.1	80	.6	91	1.2
Kansas & Franklin					6	0	2	0	39	.3	60	.6			90	1.3	22	.1	22	.2
Illinois & El Segundo					83	.6	83	1.4	41	.4	11	.1	85	.7	100	1.3	46	.4	96	1.0

ODOR INTENSITY RATING SUMMARY SHEET

Figure D-5. Summary of June ratings in TA(Hawthorne).

Panelist Location (Station)	Percent Time Detected and Mean Odor Intensity																			
	Date:6/14/71				Date:6/15/71				Date:6/16/71				Date: 6/17/71				Date:6/18/71			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M
142nd & Judah		PANELIST SCREENING AND TRAINING, NO FIELD ACTIVITIES			8	0	11	.1	1	0	0	0	89	.6	0	0	0	0	0	0
141st & Isis					16	.1	3	0	10	.1	8	0	0	0	5	0	16	.1	2	0
140th & Judah																				
138th & Judah																				
138th & Isis					38	.2	1	0	1	0	20	.1	0	0	0	0	0	0	0	0
138th & Glasgow					36	.3	30	.2	1	0	40	.3	0	0	32	.5	5	.1	0	0
137th & Isis					41	.3	27	.1					5	0	12	.1	7	.1	100	1.3
135th & Judah					16	.1	33	.3	100	1.5	39	.3	52	.6	49	.5	41	.4	33	.3
135th & Isis					51	.6	11	.1	0	0	35	.4	12	.1	33	.3	28	.2	19	.1
135th & Glasgow					66	.9	4	0	15	.1	0	0	32	.4	9	.1	5	0	17	.1
134th & Judah					56	.4	32	.3	11	.1	92	1.6	37	.3	90	.8	7	.1	10	.1
134th & Isis					51	.5	82	1.1	28	.2	46	.6	23	.1	26	.3	10	.1	34	.5
134th & Glasgow					60	.5	3	0	48	.6	49	.5	8	0	31	.3	23	.2	12	.9
Wiseburn & Judah					22	.3	78	.4	28	.2	15	.2	9	0	100	.6	67	.8	40	.4
Wiseburn & Hansworth					100	1.7	10	.1	25	.2	9	.1	1	0	44	.3	12	.1	27	.2
132nd & Hindry					84	1.3	52	.5	29	.2	8	0	7	0						

ODOR INTENSITY RATING SUMMARY SHEET

Figure D-6. Summary of June ratings in TA(El Segundo).

Panelist Location (Station)	Percent Time Detected and Mean Odor Intensity																			
	Date:6/14/71				Date:6/15/71				Date:6/16/71				Date:6/17/71				Date:6/18/71			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M
Whiting & Franklin		PANELIST SCREENING AND TRAINING, NO FIELD ACTIVITIES			96	.6	44	.6	49	.5	35	.3	55	.7	0	0	57	.5	91	1.0
Virginia & Holly					11	.1	2	0	88	.6	0	0	4	0	14	.1	0	0	0	0
Richmond & Franklin					39	.4	9	0	31	.3	81	.6	19	.2	41	.4	25	.1	60	.5
Richmond & Pine					22	.2	9	0	26	.2	0	0	28	.1	12	.1	0	0	9	.1
Eucalyptus & El Segundo					52	.3	100	.5	73	1.1	9	.1	56	.5	46	.5	50	.7	25	.3
Eucalyptus & Holly					0	0	2	.4	46	.4	0	0	8	.1	18	.2				
Penn & El Segundo					3	0	95	1.5	73	1.2	22	.1	55	.8	38	.3	50	.8	56	.7
Lomita & Franklin					28	.1	60	.8	76	.9	17	.1	45	.5	33	.2	43	.6	12	.2
Maryland & Grand					0	0	0	0	52	.6	0	0	28	.2	28	.2	13	.1	13	.1
Bungalow & Holly					1	0	17	.1	10	.1	19	.1	20	.1	0	0	9	.1	0	0
Center & Franklin					18	.1	21	.2	19	.1	78	.8	46	.4	0	0	22	.1	17	.2
Kansas & Franklin					13	.1	100	.8	63	.5	92	.6	28	.4	61	.4	44	.5	6	0
Illinois & Franklin					26	.2	20	.1	100	1.7	52	.5	22	.2	90	.6	50	.5	37	.5
Indiana & Grand					1	0	13	.1					29	.3	0	0	4	.1	20	.1

Figure D-7. Percentage of time odor was detected and mean odor intensity at panelist locations in TA(Hawthorne) during March 1971 technical field studies.

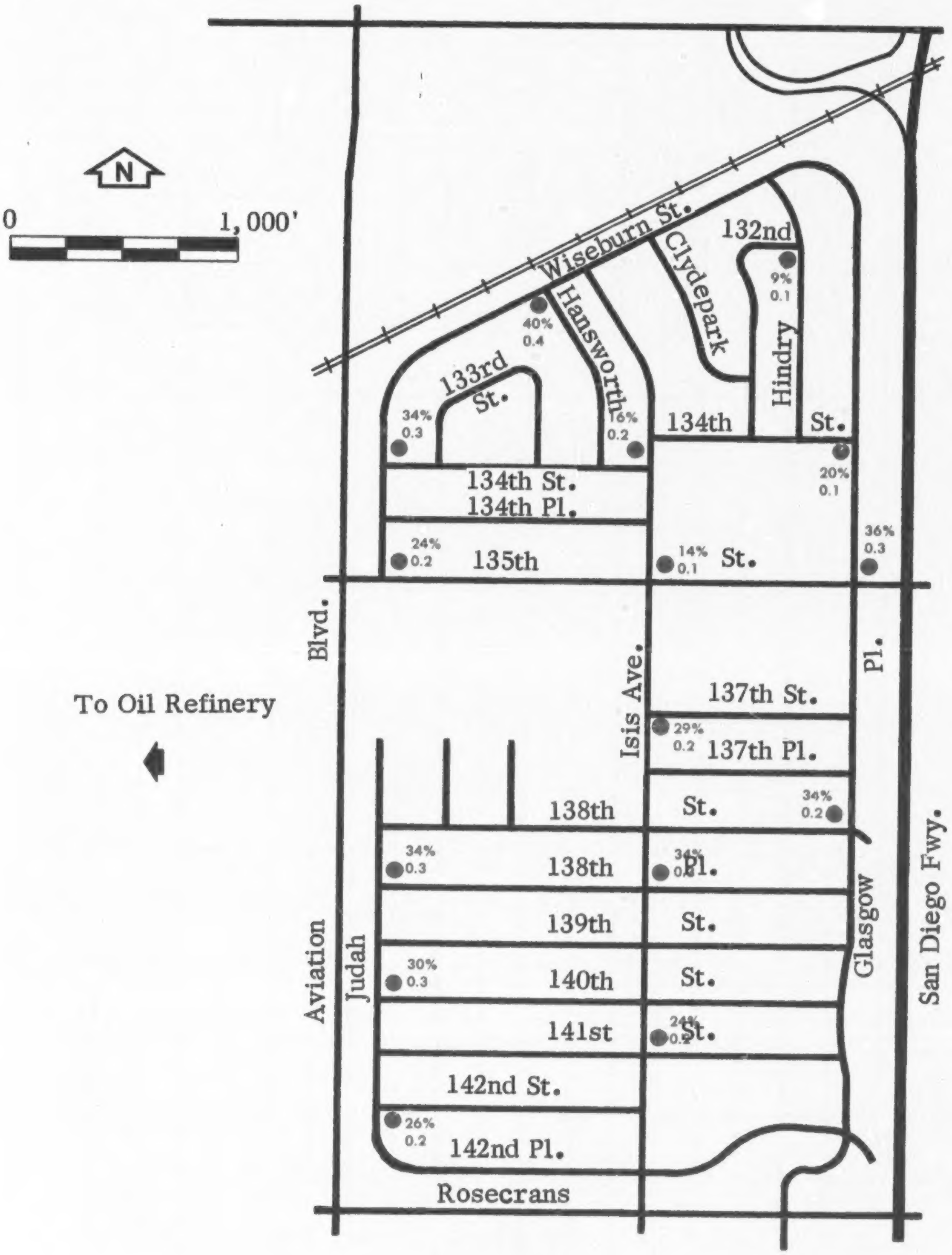

N
0
1,000'
To Oil Refinery
Wiseburn St.
132nd
9%
0.1
Clydepark
Hindry
Hansworth
40%
0.4
133rd
St.
34%
0.3
16%
0.2
134th
St.
20%
0.1
134th St.
134th Pl.
24%
0.2
135th
14%
0.1
St.
36%
0.3
Blvd.
Aviation
Isis Ave.
Pl.
Glasgow
San Diego Fwy.
137th St.
29%
0.2
137th Pl.
138th
St.
34%
0.2
34%
0.3
138th
34%
0.3
Pl.
139th
St.
30%
0.3
140th
St.
141st
24%
0.2
St.
142nd St.
26%
0.2
142nd Pl.
Judah
Rosecrans

Figure D-8. Percentage of time odor was detected and mean odor intensity at panelist locations in TA(El Segundo) during March 1971 technical field studies.

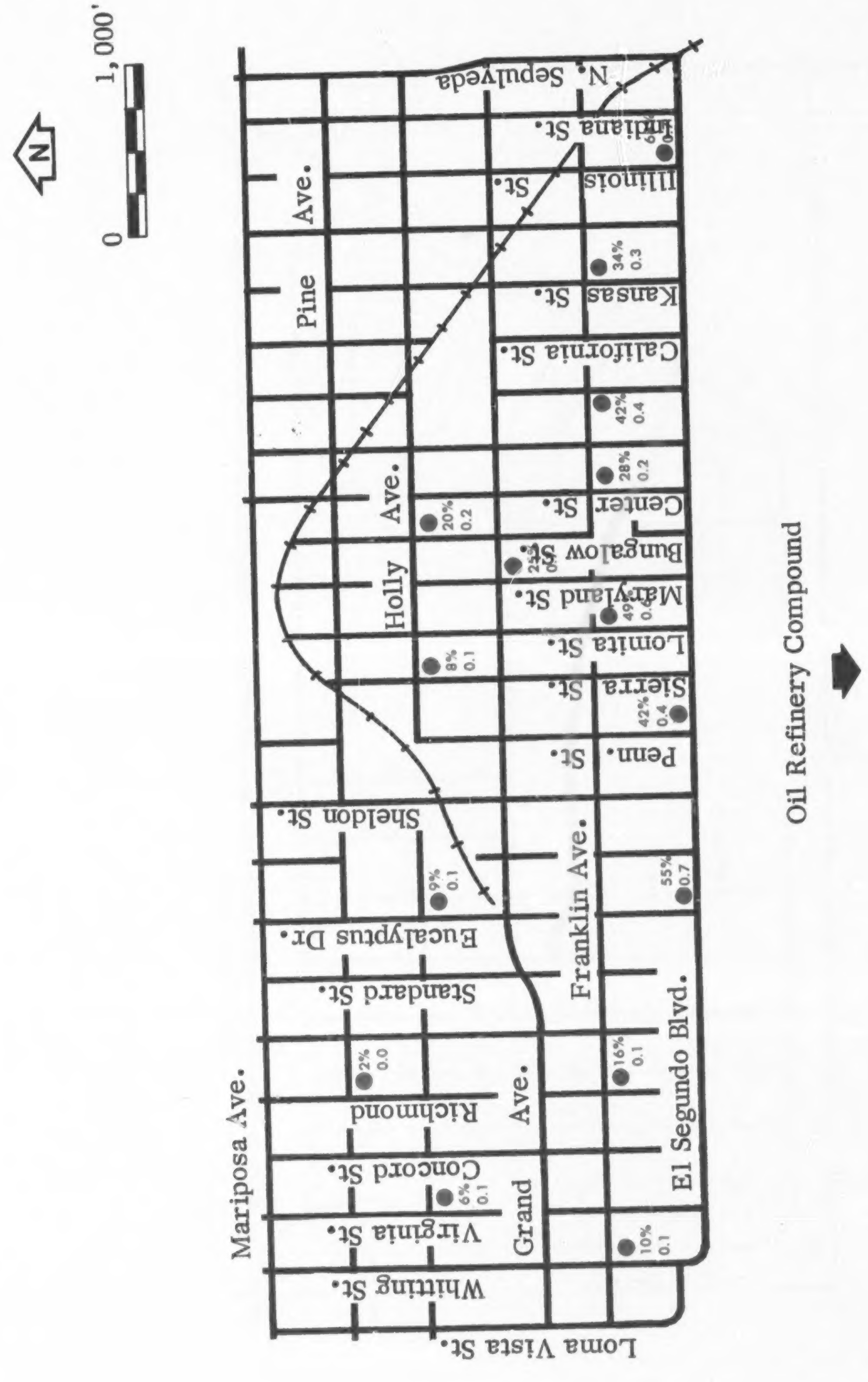

N
0
1,000'
N. Sepulveda
Indiana St.
Illinois St.
Kansas St.
California St.
Center St.
Bungalow St.
Maryland St.
Lomita St.
Sierra St.
Penn. St.
Sheldon St.
Eucalyptus Dr.
Standard St.
Richmond
Concord St.
Virginia St.
Whitting St.
Loma Vista St.
Pine Ave.
Holly Ave.
Franklin Ave.
Grand Ave.
Mariposa Ave.
El Segundo Blvd.
Oil Refinery Compound
34% 0.3
42% 0.4
28% 0.2
20% 0.2
25%
49%
8% 0.1
42% 0.4
9% 0.1
55% 0.7
2% 0.0
16% 0.1
6% 0.1
10% 0.1

Figure D-9. Percentage of time odor was detected and mean odor intensity at panelist locations in TA(Hawthorne) during June 1971 technical field studies.

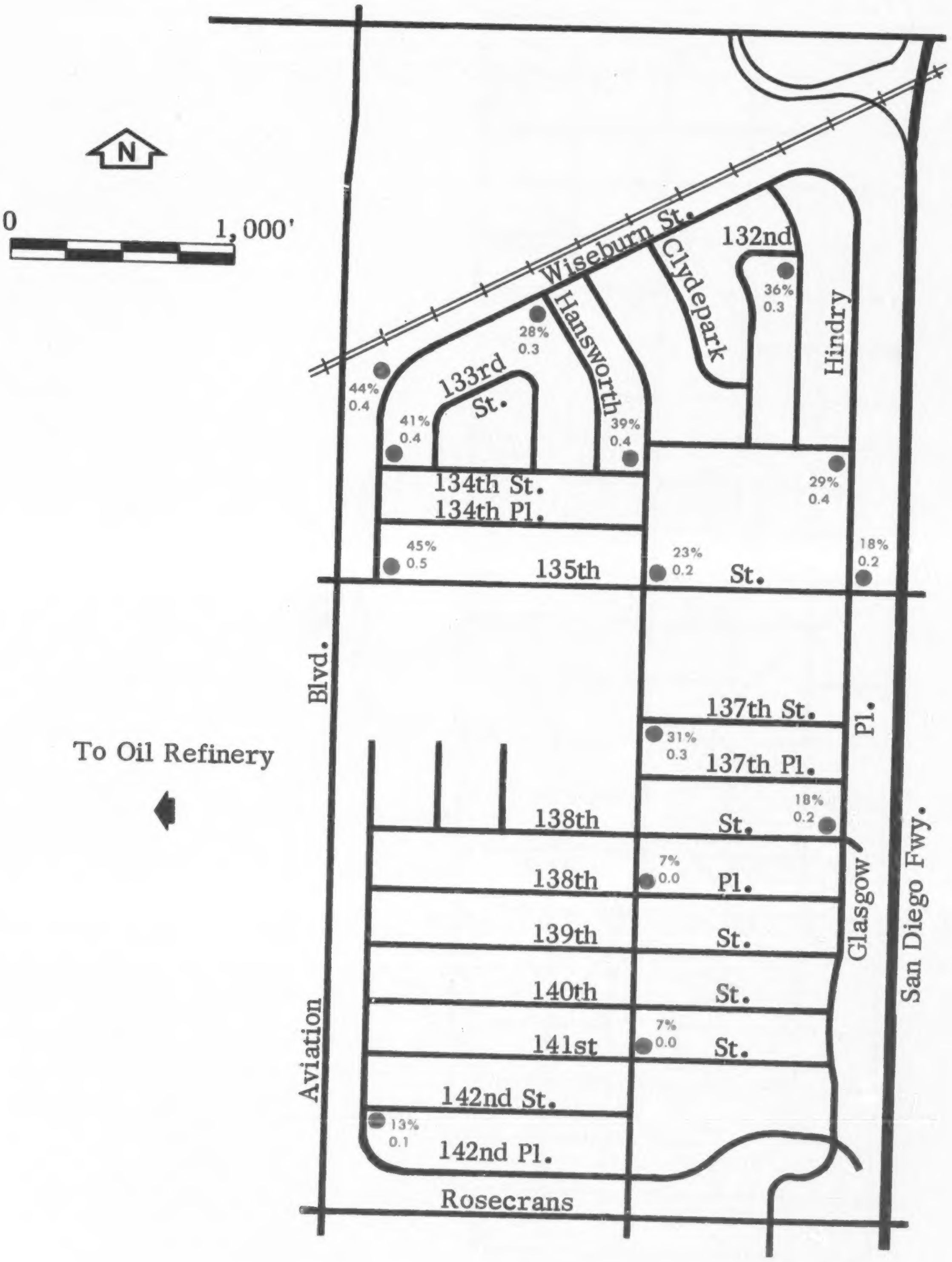
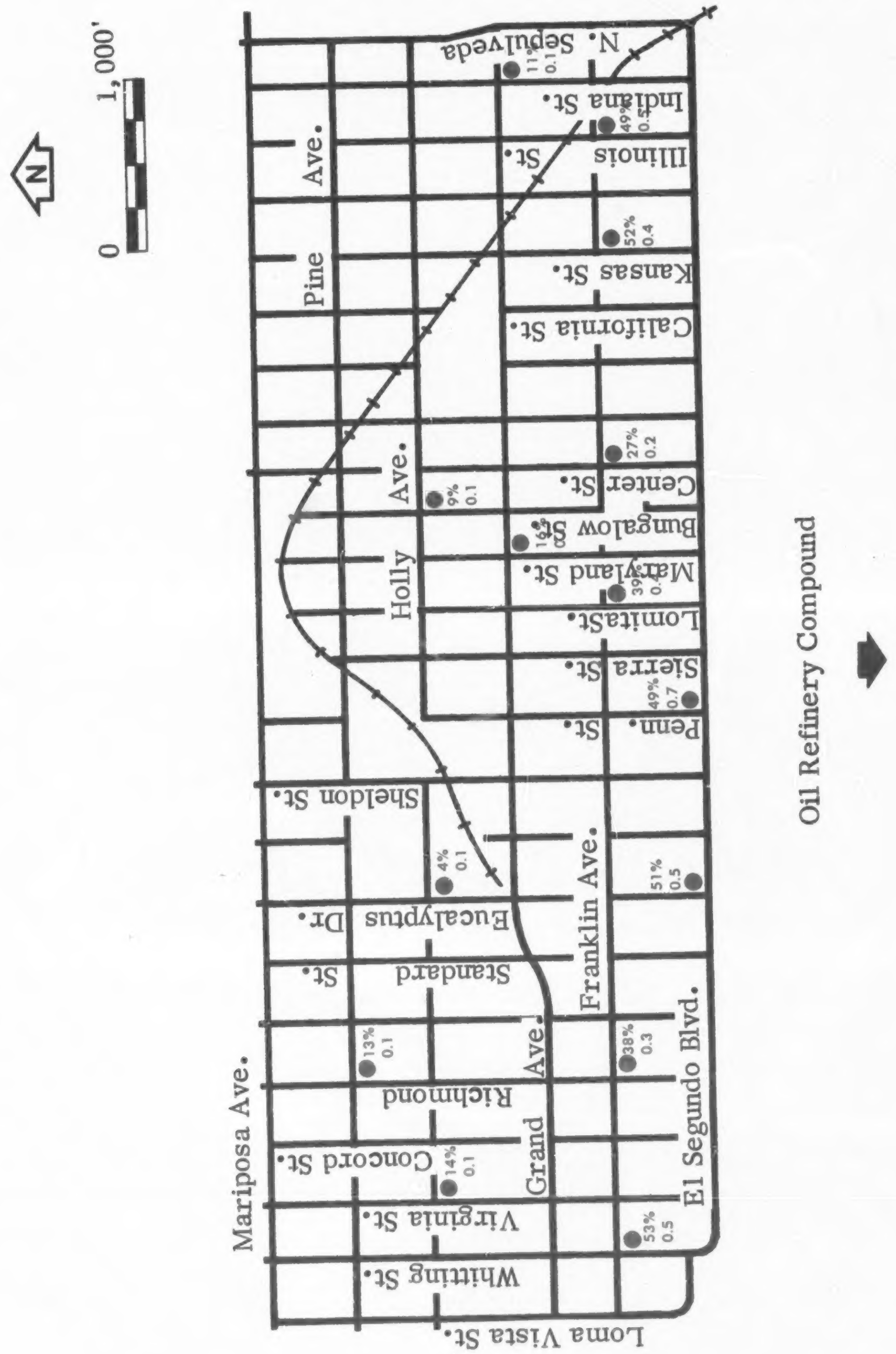

N
0
1,000'
To Oil Refinery
Wiseburn St.
132nd
Clydepark
Hindry
Hansworth
133rd St.
134th St.
134th Pl.
135th St.
137th St.
137th Pl.
138th St.
138th Pl.
139th St.
140th St.
141st St.
142nd St.
142nd Pl.
Rosecrans
Aviation Blvd.
Glasgow Pl.
San Diego Fwy.
44% 0.4
41% 0.4
28% 0.3
39% 0.4
36% 0.3
29% 0.4
45% 0.5
23% 0.2
18% 0.2
31% 0.3
18% 0.2
7% 0.0
7% 0.0
13% 0.1

Figure D-10. Percentage of time odor was detected and mean odor intensity at panelist locations in TA(El Segundo) during June 1971 technical field studies.


N
0
1,000'
Mariposa Ave.
Pine Ave.
Holly Ave.
Grand Ave.
Franklin Ave.
El Segundo Blvd.
N. Sepulveda
Indiana St.
Illinois St.
Kansas St.
California St.
Center St.
Bungalow St.
Maryland St.
LomitaSt.
Sierra St.
Penn. St.
Sheldon St.
Eucalyptus Dr.
Standard St.
Richmond
Concord St.
Virginia St.
Whitting St.
Loma Vista St.
Oil Refinery Compound
11% 0.1
49% 0.5
52% 0.4
27% 0.2
9% 0.1
16%
39% 0.4
49% 0.7
4% 0.1
51% 0.5
13% 0.1
38% 0.3
14% 0.1
53% 0.5

APPENDIX E

EFFECTS DETERMINATION QUESTIONNAIRE

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PUBLIC ATTITUDE SURVEY OF COMMUNITY ODOR PROBLEMS
EFFECTS DETERMINATION QUESTIONNAIRE

Respondent:

Phone No. ________________________________ File No. ______

Street Address ____________________________ Survey No. ______

City _____________________________________ Respondent No. ______

Record of Call:

Date	Time	Check If Interview Completed	Check If Interview Not Completed	Reason If Not Completed
______	______	( )	( )	__________

"Hello. My name is ________(name)________. I'm calling (long distance for a government agency interested in certain community problems. I'd like to talk with the man/lady of the house to get his/her opinion on a few questions. Are you the man/lady of the house?" (IF NOT, ASK: "May I talk with him/her?")

Q1) Have you lived at your present address more than six months?

___1. Yes

___2. No (SAY: "I'm sorry. This survey was designed for longer term residents. Thank you for your time.") 1______

Q2) Lately, people have become very much concerned about the environment and various types of pollution. Do people complain about any kind of pollution in your neighborhood?

___1. Yes (ASK Q3.)

___2. No (ASK Q4.) 2______

___3. Don't know (ASK Q4.)

Q3) Do people complain about...?

____1. Air pollution in your neighborhood
____2. Water pollution in your neighborhood
____3. Airport, industrial, or traffic noise in your neighborhood
____4. Noticeable odors in your neighborhood
____5. Don't know (DO NOT READ THIS RESPONSE.)

3____

Q4) Have you noticed any odors in your neighborhood in the last three months?

____1. Yes (ASK Q5.)
____2. No (SKIP TO Q23.)
____3. Don't know (SKIP TO Q23.)

4____

Q5) How often have you noticed these odors?

____1. At least once a day
____2. At least once a week, but not every day
____3. At least once a month, but not every week
____4. Less than once a month
____5. Don't know

5____

Q6) Generally speaking, how long do these odors last?

____1. At least one day
____2. At least one hour, but less than one day
____3. At least 15 minutes, but less than one hour
____4. Less than 15 minutes
____5. Don't know

6____

Q7) How strong would you say these odors smell? Would you say...?

____1. Very strong

____2. Strong

____3. Moderate

____4. Slight

____5. Don't know (DO NOT READ THIS RESPONSE.)

7____

Q8) When was the last time you noticed odors in your neighborhood?

____1. This week

____2. Last week

____3. Two to four weeks ago/a month ago

____4. More than a month ago

____5. Don't know

8____

Q9) Would you say that these odors have bothered you?

____1. Yes (ASK Q10.)

____2. No (SKIP TO Q11.)

____3. Don't know (SKIP TO Q11.)

9____

Q10) How much would you say they have bothered you? Would you say...?

____1. Very much

____2. Much

____3. Moderately

____4. Little

____5. Don't know (DO NOT READ THIS RESPONSE.)

10____

Q11) Has a strong odor ever forced you or any member of your household to go indoors?

____1. Yes (ASK Q12.)

____2. No (SKIP TO Q13.)

____3. Don't know (SKIP TO Q13.)

11____

Q12) When was that?

____1. ____

____2. Don't know

12____

Q13) Has a strong odor ever forced you or any member of your household to temporarily leave your neighborhood?

____1. Yes (ASK Q14.)

____2. No (SKIP TO Q15.)

____3. Don't know (SKIP TO Q15.)

13____

Q14) When was that?

____1. ____

____2. Don't know

14____

Q15) Have odors in your neighborhood ever made you or members of your household physically ill?

____1. Yes (ASK Q16.)

____2. No (SKIP TO Q19.)

____3. Don't know (SKIP TO Q19.)

15____

Q16) In what way?

____1. Nausea

____2. Headaches

____3. Affected breathing/caused coughing or choking 16____

____4. Other answer(s): ________________________________

____

____5. Don't know

Q17) Has any member of your household visited a doctor because of these illnesses?

____1. Yes (ASK Q18.)

____2. No (SKIP TO Q19.) 17____

____3. Don't know (SKIP TO Q19.)

Q18) When was that?

____1. ____

18____

____2. Don't know

Q19) How much are homes in your neighborhood selling for lately?

____1. ________________________________ dollars

19____

____2. Don't know

Q20) Have odors reduced the value of homes in your neighborhood?

____1. Yes (ASK Q21.)

____2. No (SKIP TO Q22.) 20____

____3. Don't know (SKIP TO Q22.)

Q21) In what way?

____1. Potential buyers are discouraged

____2. Owners are anxious to move away

____3. Other answer(s): ______________________ 21____

____4. Don't know

Q22) Where would you say most of the odors in your neighborhood originate, that is, who or what causes them?

____1. Source(s) being investigated

____2. Other source(s): ______________________ 22____

____3. Don't know

"All this information is strictly confidential, but we need it for statistical purposes."

Q23) What company do you work for?

____1. Source(s) being investigated

____2. Other company/none: ______________________ 23____

____3. Refused

Q24) What companies do other members of your household work for?

____1. Source(s) being investigated

____2. Other company(ies)/none: ______________________ 24____

____3. Refused

"That completes the interview. Thank you very much for your time."

Interviewer's Name: ______________________________

APPENDIX F

GLOSSARY OF TERMS

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APPENDIX F

GLOSSARY OF TERMS

Acute Episode	Causation of odors beyond the property limits of a source, occurring no more than once and lasting no more than one day in any three month period.
Chronic Situation	Causation of odors beyond the property limits of a source, occurring more than once or lasting more than one day in any three month period.
Dose/Response	The degree and type of human response caused by variations in exposure to different intensities and/or other characteristics of odors.
Economic Effects	Consequences of odors that can be measured in monetary terms, e.g., reduced value of real estate, increased maintenance costs, and lost of work productivity.
Noise	Responses based on the interaction of variables other than the one of concern to the research team; specifically, responses by individuals that they noticed or were bothered by odors in their neighborhoods when the location of sources or meteorological conditions were such that odors could not have been detected.
Odor	(1) Perception of smell, referring to the experience; (2) an odorant.
Odorant	That which is smelled, referring to the stimulus; a substance that stimulates the olfactory receptors.
Odorous Emission	Release of an odorant, or a combination of odorants that can be smelled, into the atmosphere.
Odor Judgment Panel	A group of individuals selected on the basis of their sensitivity to odorants, the reliability of their evaluation of odors, and their having socioeconomic characteristics similar to the population of a community under study as an odor problem area. The panel is used to obtain information concerning the subjective attributes of odors perceived in that community.

Odor Plume	A three dimensional, featherlike pattern of an odorant, or a combination of odorants that can be smelled, emanating and diffusing from a point source.
Reference Standard	A laboratory prepared sample of a non-toxic, stable chemical that closely matches the odor under investigation and which, when mixed to various concentrations, is used to train odor judgment panel participants to recognize the strengths of the odor perceived during field investigations.
Scentometer	A device for odor measurement by sensory techniques that employs vapor dilution methods in which the odor is diluted with increasing volumes of odorless air until it is just discernible.
Signal	Responses based on the interaction of the variable of concern to the research team, specifically responses by individuals that they noticed or were bothered by odors when odors were actually present.
Social Effects	Consequences of odors that can be measured only in subjective or medical terms; specifically, illness and changes in preferred life style, e.g., being forced to stay indoors because of odors.
Triangle Test	A psychophysical method for determining whether a difference between two odorants can be detected, in which individuals are asked to choose which of three odorants is the odd or different one, where two are alike and one is different.

ANNOTATED BIBLIOGRAPHY

A. EFFECTS OF ODOR POLLUTION ON THE COMMUNITY

Deane, Margaret, and Goldsmith, John R. "Health Effects and Annoyance Reactions to Pulp Mill Odor in a Rural Community." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

Results of a study conducted in a rural community exposed to odors from a pulp mill are presented. Three levels of exposure were tested and compared.

DeGroot, Ido. "Trends in Public Attitudes Toward Air Pollution," *Journal of the Air Pollution Control Association*, XVII, No. 10 (October, 1967), 679-681.

Findings relative to people's attitudes regarding the air pollution problem from a series of studies conducted by the U. S. Public Health Service are reported, and trends are noted.

Engen, Trygg. "Method and Theory of Odor Preference." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

This paper takes a developmental view of the hedonics of odor perception in considering the general problem of method and theory. Results of studies with adults and children are discussed.

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Flesh, R. David. "Property Value Differentials as a Measure of Economic Costs Due to Odors." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

Two methods of measuring property value differentials due to odors — the "other things equal" approach and the problem rating scale — are presented and discussed. Preliminary findings of a present study of the first method are presented.

________. "Public Opinion of Odors in Seven Metropolitan Areas." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

This paper discusses a study which surveyed all local air pollution control agencies in the nation and public opinion of odors in seven metropolitan areas. The paper describes the development of the public opinion survey and summarizes the results.

Foster, Dean. "Working Paper for Stockholm Methods Conference." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

This paper discusses the lack of previous attention devoted to the public health importance of odor because of difficulties regarding scientific measurement and the lack of easy verbalization of response patterns. The author calls for a better use of resources to define the problem.

Friberg, Lars, Jonsson, Erland, Rylander, Ragnar, and Ubisch, Hans V. "Reactions to Environmental Disturbance Factors Caused by Oil Refineries." Institute of Hygiene Karolinska Institutet, Department of General Hygiene, National Institute of Public Health, Stockholm, and Institute of Hygiene Umea University, Umea, undated.

A discussion of a prognosis made for the expected annoyance reaction in the population around a new refinery is presented. The prognosis was based on a technical investigation, literature studies, and an interview survey.

Goldsmith, John R. "A Suggested Odor Scaling System." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

This paper prepares a logarithmic scale which establishes the relationship between odorant presence, odor-dilution panel study responses, and the extent to which populations are bothered by odor exposure.

Jonsson, Erland. "On Annoyance Reactions Observed Within Human Populations." Paper presented at the working conference on The Dose Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

The effects of offensive odors on the exposed population as reported in a number of investigations are reviewed.

________, Deane, Margaret, and Sanders, George. "Community Reactions to Odors from Pulp Mills: A Pilot Study in Eureka, California." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

The purpose of this study was to determine whether or not it is possible to measure the relationship between quantitative data describing exposure and quantitative data describing community reactions. The results of the study showed a definite association between exposure data and reaction data.

Kigo, Tetsutaro, Endo, Ryosaku, Tatsunori, Oyake, and Shirakawa, Hiroshi. "Offensive Odors. 9. Investigation of the Existing Conditions in Hokkaido With Respect to Offensive Odors." First Report. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), II, No. 1 (1967), 48-58 (Translation).

This article is a report of an investigation of the sources of odors, damage being caused, and consequent reactions and attitudes of local residents in Hokkaido.

Pavenello, R., and Rondia, D. "Odour Nuisance and Public Health." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

This paper reviews some of the technical problems associated with odor pollution as well as public health problems, reactions, and prevention of pollution by odoriferous products.

Sadilova, M. S. "Studies in the Standardization of Maximum Allowable Hydrogen Fluoride Concentrations in the Air of Inhabited Areas," in The Biological Effects and Hygienic Importance of Atmospheric Pollutants, Book 10 (U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, 1968), XVII, 118-128.

An investigation of the levels of atmospheric fluorine found near aluminum and cryolite plants, accompanied by a survey of the health of children who live in these areas has shown that the establishment of the maximum allowable concentration of fluorine is imperative. Odor perception thresholds and physical effects of HF on warm-blooded animals are presented.

Springer, Karl J. "Studies of Public Opinion of a Traffic Odor." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

This paper describes an effort to acquire public opinion of diesel exhaust in terms of the Turk kit panel ratings of the same odor. The intent of the study was to relate and close the loop between technology, measurement, and response.

________, and Hare, Charles T. "A Field Survey to Determine Public Opinion of Diesel Engine Exhaust Odor." Final Report. Southwest Research Institute, San Antonio, Texas, Vehicle Emissions Research Laboratory, NAPCA Contract PH 22-68-36, February, 1970.

This study developed a workable method of sampling public opinion of diesel exhaust odor by using a calibrated mobile odor evaluation laboratory. Five cities were surveyed. Unsolicited comments made during the survey seemed to indicate that high local pollution and/or high awareness of it are associated with a more objectionable characterization of odors, and vice versa.

Summer, W. "Odor Research in Europe: A Report," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 361-368.

The approach to the practical problems of odor research in Europe differs from that in the United States. The author provides a picture of research in Europe and the implications of and reasons for much of the work that is being carried out.

B. EFFECTS OF ODOR POLLUTION ON THE INDIVIDUAL

Altner, H. "Neurological Responses to Odorants." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

A brief survey of the neurological responses to odorants of some animals is provided. Topics covered are the input to the central nervous system, pathways in the olfactory centers of mammals, electrophysiological investigation of the olfactory bulb and related forebrain structures.

Amoore, John E. "Current Status of the Steric Theory of Odor," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 457-476.

This paper incorporates an illustrated outline of the stereochemical theory of olfaction, together with some historical information. Independent lines of research which have confirmed this theory are reviewed.

Berglund, B., Berglund, V., Engen. T., and Lindvall, T. "The Effect of Adaptation on Odor Detection," *Perception and Psychophysics*, IX (May, 1971), 435-438.

The sensitivity of human subjects to a weak odor following prior exposure to it varying in both duration and concentration was studied. The effect of adaptation was demonstrated, and the findings suggest that the sense of smell is more stable than is usually believed.

Cain, William S. "Odor Intensity. Differences in the Exponent of the Psychophysical Function," *Perception and Psychophysics*, VI (December, 1969), 349-354.

The results of a series of experiments showing that there are reliable differences among the exponents of the psychophysical power functions for odorants are discussed.

Chzhen-tsi, Chzahao. "Basic Experimental Information for the Determination of the Limit of Allowable Methanol Concentration in Atmospheric Air," in *Limits of Allowable Concentrations of Atmospheric Pollutants*, V. A. Ryzaznov (ed.), Book 5 (Washington, D.C.: U. S. Public Health Service, March, 1962), 67-68.

Studies were conducted of the presence and effects on rats and humans of methanol as an atmospheric pollutant. An odor perception threshold was determined for sensitive persons, and it was concluded that methanol-emitting pharmaceutical and chemical plants should not be located near residential areas and should be equipped with adequate control equipment.

Colucci, Joseph M., and Barnes, Gerald J. "Evaluation of Vehicle Exhaust Gas Odor Intensity Using Natural Dilution." Preprint, Society of Automotive Engineers, Inc., New York, 1970.

A discussion of panel test procedures developed for field evaluation of full-scale vehicle exhaust odor as well as odor tests in a controlled environment is presented. The procedure is capable of discriminating between two odor sources of differing intensity.

Dravnieks, Andrew. "Physicochemical Basis of Olfaction," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 429-439.

A qualitative model of an olfactory chemosensor is proposed.

Ekman, Gosta, Berglund, Birgitta, Berglund, Ulf, and Lindvall, Thomas. "Perceived Intensity of Odor as a Function of Time of Adaptation," *Scandanavian Journal of Psychology*, VII (1967), 177-186.

Two experiments were conducted to determine the perceived intensity of odor under conditions of constant stimulation with hydrogen sulfide. An exploratory investigation was also made of the process of recovery of sensitivity after stimulation had ceased.

Engen, Trygg. "Effect of Practice and Instruction on Olfactory Thresholds," *Perceptual and Motor Skills*, X (June, 1960), 195.

This study concerned the measurement of olfactory thresholds by a forced-choice method of limits. It was found that practice lowered thresholds appreciably as did changes in the criterion of discrimination.

________. "Psychophysical Scaling of Odor Intensity and Quality," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 504-516.

This paper summarizes some experiments with the direct psychophysical scaling methods.

________, and Pfaffmann, Carl. "Absolute Judgments of Odor Intensity," *Journal of Experimental Psychology*, LVIII (July, 1959), 23-26.

This article discusses the ability of the human subject to transmit information about odor intensity. The experiments concerned the greatest number intensities of an odor that can be identified correctly by rank order, and how the accuracy of identification is influenced by other factors, such as selection of odorants, intensity of stimuli, practice, etc.

________, and Pfaffmann, Carl. "Absolute Judgments of Odor Quality," *Journal of Experimental Psychology*, LIX (April, 1960), 214-219.

This study was concerned with the recognition of odor qualities and the application of information theory to the evaluation of the human observer.

Epstein, Samuel S. "Carcinogenicity of Organic Extracts of Atmospheric Pollutants," *Journal of the Air Pollution Control Association*, XVII, No. 11 (November, 1967), 728-729.

Results of a study of the carcinogenicity of atmospheric pollutants by the injection of trace quantities of organic extracts in newborn mice are reported. Experiments indicated a high potential hazard of carcinogenic polluted air to man.

Foster, Dean. "Odor Correlation and the Panel Technique — 1953," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 482-483.

A brief review of the panel technique in 1953 and some of the progress made between 1953 and 1963 are noted.

Friberg, Lars. "Summary of Technical Problems." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

This paper discusses odor pollution in terms of the response, the dose, and the dose-response relationships. Possible ways to approach the various odor problems and the issues themselves are the focal points.

Friedman, Herman H., Mackay, Donald A., and Rosano, Henri L. "Odor Measurement Possibilities via Energy Changes in Cephalin Monolayers," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 602-607.

After finding that the influence of air, in addition to the adsorption process, during olfaction is important, the authors attempted to build an artificial nose.

Gesteland, Robert C. "Initial Events of the Electro-Olfactogram," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 440-447.

This paper presents the results of experiments using a wide variety of stimulating substances. Conclusions about the early events associated with EOG are also provided.

Hahn, John F. "Some Relations Between Smell and Other Sensory Response Systems," *Annals of the New York Academy of Sciences*, CXVI, Art 2 (July, 1964), 559-563.

Olfaction is discussed and several comparisons are made between the phenomena associated with the other senses and that understood in the sense of smell.

Hainer, Raymond M. "Some Suggested Critical Experiments in Olfactory Theory," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 477-487.

This paper suggests several critical experiments to stimulate interest in thinking about olfaction as a total perceptual system and in thinking about extended applications in product research.

Herbert, M., Glick, R., and Black, H. "Olfactory Precipitants of Bronchial Asthma," Journal of Psychosomatic Research, XI (August, 1967), 195-202.

The findings of this study indicate that olfactory stimuli play an important role in precipitating asthmatic attacks.

Izmerov, N. F. "Atmospheric Air Pollution With Gasoline Vapor and Its Limit of Allowable Concentration," in Limits of Allowable Concentrations of Atmospheric Pollutants, V. A. Ryzaznov (ed.), Book 5 (Washington, D.C.: U. S. Public Health Service, March, 1962), 52-67.

A report of a study concerning the effects of solvent gasoline vapors emitted from crude oil on conditioned reflex reactions, odor thresholds, and eye sensitivity is presented. Recommendations for allowable concentrations of low-sulfur gasoline vapor are presented as well as proposed sanitary clearance zones around plants emitting such vapors.

Jones, F. Norvell. "Subjective Scales of Intensity for Three Odors," American Journal of Psychology, LXXI (June, 1958), 423-425.

The subjective intensities of different concentrations of benzene, heptane, and octane were scaled by the method of magnitude estimation. This study showed that olfactory intensity obeys the law proposed by Stevens for subjective intensities.

Karneyev, Yu E. "Determination of Allowable Maximum Concentrations of Phenol and Acetophenone When Simultaneously Present in Atmospheric Air," in The Biological Effects and Hygienic Importance of Atmospheric Pollutants, Book 10 (U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, 1968), XVII, 97-107.

The combined effect of phenol and acetophenone vapors on the human organism was studied. Odor threshold levels for sensitive persons are presented.

Kendall, David A., and Jacobs, Stanley P. "Physiological Responses to Odorants." Paper presented at the working conference on the Dose-Response Relationships Affecting Human Reactions to Odorour Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

This paper reports the results of a study where odorants were presented to subjects on a totally blind basis, while concentrations and duration of stimulus were controlled and a number of autonomic responses were monitored.

Mayers, Martin A. "Odor Technology: Where We Are, Where We Are Going," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 369-377.

A review of the knowledge of the olfactory system, measurement and control, and some recommendations for further study are provided.

McNamara, B. P., and Danker, W. M. "Odors and Taste," in *Basic Principles of Sensory Evaluation* (American Society for Testing and Materials, Philadelphia, Pennsylvania, STP-433, 1968), 13-18.

Difficulties encountered in evaluating response to odor and taste are discussed. Theories of the olfactory sense are discussed.

Mitchell, M. J., and Gregson, R. A. "Stimulus Specificing and Thresholds of the Chemical Senses." Research Project, University of Canterbury, New Zealand (1968), No. 14.

This paper is a report of a study where subjects took 10 ml. of ethanol orally. Results indicate that marked changes in psychophysical behavior occur when small amounts of some contaminants are present in absolute threshold determinations. Impurities are found to influence olfactory thresholds.

Moulton, David G. "Nasal Responses to Chemical Stimulation." Final Report. Pennsylvania University, Philadelphia, Monell Chemical Senses Center, Grant DAHC 19-68-G-0026, Report 1, September, 1969.

This paper discusses a study on the properties of the nasal trigeminal and olfactory systems which were explored in rat and man using electrophysiological, anatomical, and behavioral techniques.

________, and Tucker, D. "Electrophysiology of the Olfactory System," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 380-428.

A survey of studies on the electrical activity associated with stimulation of the odor receptors and accessory structures is presented. An extensive bibliography is provided.

Ottoson, David G. R. "How We Recognize Odors," *New Scientist*, XLVIII, No. 723 (October, 1970), 114-116.

The direct correlation between the subjective sensation of small and the electrical activity in particular cells of the nasal cavity is discussed. Findings from recent research are indicated.

Rosano, Henri L., and Scheps, Sheldon Q. "Adsorption-Induced Electrode Potential in Relation to Olfaction," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 590-601.

The authors attempted to develop an artificial nose and found that galvanic phenomena can be applied to gas and vapor analysis. The working conditions and a probable mechanism to be used are advanced.

Ryozanov, V. A. "Sensory Physiology as Basis for Air Quality Standards," *Archives of Environmental Health*, V (November, 1962), 480-494.

A discussion of the need for clean air, a method for determining some odor thresholds, effects of odors on the respiratory system, and results of several studies regarding the influence of aromatic substances on the human central nervous system are presented.

Schneider, Robert A., and Wolf, Stewart. "Olfactory Perception Thresholds for Citral Utilizing a New Type Olfactorium," *Journal of Applied Physiology*, VIII (1955), 337-342.

This paper describes a relatively odor-free, temperature and humidity controlled, walk-in olfactorium and preliminary observations on odor perception thresholds using this olfactorium.

Schutz, Howard G. "Odor Theory, Physiology, and Chemistry," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 378-379.

Ideas that were indicated in the 1963 Odor Conference held at the New York Academy of Sciences are briefly noted.

Springer, Karl J., and Dietzmann, Harry E. "Correlation Studies of Diesel Exhaust Odor Measured by Instrumental Methods to Human Odor Panel Ratings: Progress Report." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

This discussion centers around attempts to extend the usefulness of the trained human odor panel by means of a chemical-instrumental method developed at the Southwest Research Institute, San Antonio, Texas.

Stone, Herbert, and Dryer, Gordon. "Some Properties of the Olfactory System of Man," Perception and Psychophysics, II (November, 1967), 516-518.

Preliminary investigations into the effects of a twelve-hour diurnal variation suggested there was a tenfold decrease in odor sensitivity from morning to evening. Blindfolding subjects and auditing stress on the test situation did not significantly alter odor sensitivity.

Terraglio, Frank P., and Manganelli, Raymond M. "The Absorption of Atmospheric Sulfur Dioxide by Water Solutions," Journal of the Air Pollution Control Association, XVII, No. 6 (June, 1967), 403-406.

This article presents a technical discussion of a laboratory study to determine the rate and extent of absorption of atmospheric sulfur dioxide by distilled water surfaces. The information was used in part to determine the possible health effects concerning solutions of acid gases.

Tkach, N. Z. "Combined Effects of Low Acetone and Acetophenone Concentrations In the Air of the Living Organism," in The Biological Effects and Hygienic Importance of Atmospheric Pollutants, Book 10 (U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, 1968), XVII, 108-117.

The effects of low acetone and acetophenone concentrations on the living organism were determined. The odor perception threshold concentration was determined using the most sensitive test persons for acetone, for acetophenone, and for a mixture of these two compounds. Recommended minimum perceptible concentrations are presented.

Wilby, F. V. "Variation in Recognition Odor Threshold of a Panel," Journal of the Air Pollution Control Association, XIX (February, 1969), 96-100.

This paper is a report of a study designed to correlate the odor strength of natural gas with its sulfur analysis. The recognition odor thresholds of 18 sulfur compounds were determined, using an untrained panel of 35 people.

Wright, Robert Hamilton. "Odor and Molecular Vibration: The Far Infrared Spectra of Some Perfume Chemicals," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 552-558.

The vibrational theory of olfaction is discussed in detail. Results of studies lend some support to this theory.

C. ODOR MEASUREMENT AND EVALUATION TECHNIQUES

Adams, D. F., Koppe, R. K., and Tuttle, W. N. "Analysis of Kraft-Mill Sulfur Containing Gases With GLC Ionization Detectors," *Journal of the Air Pollution Control Association*, XV, No. 1 (January, 1965), 31-33.

This paper describes a technique which includes the use of two chromatographic columns in series to separate O_2, N_2, CO, H_2O, H_2S, and CH_3SH. The conditions required to obtain adequate sensitivity and separations are discussed.

________. "Physical-Chemical Measurements of Odorous Pollutants," Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

A discussion of the analytical methodologies available for measuring those sulfur containing gases which are most significant to the kraft pulp industry is presented. The article traces instrumental analysis in two major areas: source gases and ambient air.

Baker, Robert A. "Response Parameters Including Synergism-Antagonism in Aqueous Odor Measurement," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 495-503.

This paper reviews a program of study concerning odor in water, the existing test methods, and the effect of variables, interactions, and complex mixtures.

Beck, Lloyd Henry. "A Quantitative Theory of the Olfactory Threshold Based Upon the Amount of the Sense Cell Covered by an Adsorbed Film," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 448-456.

The author discusses the development of a hypothesis concerning a relationship between molecular structures and the threshold concentration of odorous substances so that the threshold is predictable.

Bemforado, D. M., Rotella, W. J., and Haton, D. L. "Development of an Odor Panel for Evaluation of Odor Control Equipment," Journal of the Air Pollution Control Association, XIX (February, 1969), 101-105.

Test data show that an odor evaluation panel using the syringe dilution technique is a useful and practical tool in quantitatively analyzing industrial odors.

Berglund, B., Berglund, V., Ekman, G., and Engen, T. "Individual Psychophysical Functions for Twenty-Eight Odorants," Perception and Psychophysics, IX (March, 1971), 379-384.

Individual scales of odor intensity were obtained for 28 different chemical compounds by the method of magnitude estimation. Additional results of the experiments for this study, concerning power functions which describe the relationship between partial vapor pressure of the odorants and their subjective odor intensity, are also provided.

Bozza, G., Calearo, C., and Teatini, G. P. "On the Making of a Rational Olfactometer," Acta Oto-Laryngologica, LII (September, 1960), 189-209.

A new olfactometer is extensively described. Some of the main features are: (1) exact and constant concentration of odorous substances, (2) stimulation in natural conditions, and (3) the possibility of changing stimulus during the interval between one inspiration and the following one.

Brosset, Cyrill. "The Stability of Emitted Odorous Substances in the Atmosphere." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

A summary of the reactions on the atmospheric chemistry of emitted odorous substances is provided. The compounds discussed in this article are those of significance in the emission from sulfate mills.

Byrd, J. F. "Demonstration — Syringe Odor Measurement Technique," Journal of the Air Pollution Control Association, LVIII (May, 1957), 58-59.

Odor measurement is discussed in general, and one method using the syringe is discussed in detail.

Cain, William S. "Odorant Differences in the Scaling of Olfactory Intensity," Psychonomic Bulletin, I (1967), 8.

Direct scaling od odor intensity with an air-dilution olfactometer extended previous results that the water solubility of odorants is correlated with steepness of intensity scales.

Cerderlof, Rune, Edfors, Marie-Louise, Friberg, Lars, and Lindvall, Thomas. "On the Determination of Odor Thresholds in Air Pollution Control — An Experimental Field Study on Flue Gases From Sulfate Cellulose Plants," Journal of the Air Pollution Control Association, XVI (February, 1966), 92-94.

A field method designed for estimating the odor thresholds of flue gases emitted from different industrial processes is discussed. Results of two studies and a discussion of the practical application of the method are provided.

Czerwonka, L. J., Boylan, R. J., and Gonzalez, D. J. "Accelerated Test Method for Determination of Odor Control Devices," Annals of the New York Academy of Sciences, CXVI, Art 2 (July, 1964), 613-620.

Gas chromatographic devices were investigated as an accelerated test method for evaluating sorptive beds. This paper reviews one accelerated test method under study.

Doving, Kjell B., and Lange, Anders L. "Comparative Studies of Sensory Relatedness of Odors," Scandanavian Journal of Psychology, VIII, (1967), 47-51.

Measures of relatedness of odors were obtained by means of two psychophysical methods and one electrophysiological technique. Significant rank correlations were obtained between the results of the three methods.

Dravnieks, Andrew, and Laffort, Paul. "Possibilities of Predicting Odor Intensity and Quality by Means of Chemical Analysis." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

A discussion of the suitable techniques and correlations which have emerged concerning the translation of chemical analytical data into organoleptic parameters describing odor intensity and quality is presented.

Duffee, R. A. "Appraisal of Odor-Measurement Techniques," *Journal of the Air Pollution Control Association*, XVIII (July, 1968), 472-474.

Relative advantages and disadvantages of odor measurement methods are discussed. Applications and suggested modifications are also presented.

Ekman, Gosta. "A Direct Method for Multidimensional Ratio Scaling," *Psychometrika*, XXVIII (March, 1963), 33-41.

A generalization of direct ratio scaling methods for multidimensional ratio scaling is described. The method was developed to meet requirements for experimentation in several areas including olfaction.

________, Berglund, Birgitta, Berglund, Ulf, and Lindvall, Thomas. "Perceived Intensity of Odor as a Function of Time of Adaptations," *Scandanavian Journal of Psychology*, VIII (1967), 177-186.

The perceived intensity of odor under conditions of constant stimulation with hydrogen sulfide was investigated in two experiments. Perceptional intensity was found to decrease exponentially with increase of time and stimulation.

Engen, Trygg. "Organoleptic Measurements of Odor Qualities." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

A discussion of the recent psychophysical approach to the quality of odors which rejects verbal labels and attempts instead to increase the generality of the data by simplifying the responses and testing them against multidimensional mathemetical models is presented.

________, and McBurney, Donald H. "Magnitude and Category Scales of the Pleasantness of Odors," *Journal of Experimental Psychology*, LXVIII (November, 1964), 435-440.

The pleasantness of odors was judged by the method of magnitude and the category method. Comparison of the results of the two methods suggests a reason for the general lack of agreement between them.

Foster, D., Scofield, E. H., and Dallenbach, K. "An Olfactorium," *American Journal of Psychology*, LXIII (July, 1950), 431.

A detailed description and explanation of an olfactorium, an odor-proof cubical, is presented. This cubical serves as a laboratory for qualitative research and as part of an olfactometer for quantitative investigations.

Fox, E. A., and Gex, V. E. "Procedure for Measuring Odor Concentration in Air and Gases," *Journal of the Air Pollution Control Association*, LVIII (May, 1957), 60-61.

A procedure for determining the odor concentration in the atmosphere and in gases discharged from industrial process operations and for determining the odor emission rate from a stack or a vent is presented in detail.

Gerstein, H. H. "A Continuous Odor Monitor and Threshold Tester," *American Water Works Association Journal*, XLIII (May, 1951), 373-377.

Use of a continuous odor monitor and threshold tester which provides a quick means for determining the type and intensity of an odor at any given time and also makes possible a frequent check on the efficiency of the treatment process is presented.

Hemeon, Wesley C. L. "Technique and Apparatus for Quantitative Measurement of Odor Emissions," *Journal of the Air Pollution Control Association*, XVIII (March, 1968), 166-170.

A description of the instruments and techniques developed by the author over a period of years for the quantitative measurement of odor emissions at the source is presented. The system is based on quantitative dilution and human subjects. It is a dynamic method which emphasizes a large volume of samples and an odormeter to avoid loss of odor on the walls.

Hendrickson, E. R. "Needs for Future Research." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

This paper outlines several crucial research problems concerning the measurement and evaluation of odors which must be solved before odorous emissions can be controlled.

Henion, Karl E. "Psychophysical Scales of the Olfactory Pleasantness of Homologous Alcohols," Perception and Psychophysics, IX (February, 1971), 234-236.

The results of a study which established a category, a ratio estimation, and three magnitude scales from the observations of subjects who judged the pleasantness of a homologous series of naliphatic alcohols is presented.

________. "Subjective Range of the Odor Oiliness of Heptanol," Journal of Experimental Psychology, LXXXII (December, 1969), 515-519.

The results of experiments on the oiliness of agrometric dilution series of N-heptanol are presented as well as a category, a ratio estimation, and three magnitude scales.

Hogstrom, Ulf. "Predicting Odor Frequencies by Dispersion Calculations." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

The problem of making odor dispersion calculations is discussed and a method for making such calculations is advanced.

Horstman, S. W., Wromble, R. F., and Heller, A. N. "Identification of Community Odor Problems By Use of an Observer Corps," Journal of the Air Pollution Control Association, XV, No. 7 (June, 1965), 261-264.

Approximately 120 high school students were used to collect odor data. Data were reviewed to show severely affected areas, objectionable odor types, frequency of odors, and associated weather parameters.

Huey, N., Broering, L., Jutze, G., and Gruber, C. "Objective Odor Pollution Control Investigations," Journal of the Air Pollution Control Association, X (December, 1960), 441.

Objective odor pollution control investigations associated with various manufacturing processes are the topic of this article. Included in the article are discussions of: The Nature of Ambient Odors, Measurement of Odor Strength — the Scentometer, Source Location, Standard Procedure for Ambient Odor Investigation, and Meteorological Effects on Odor Nuisance Occurrences.

Hurn, R. W. "Source and Measurement of Odorous Engine Products." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

This paper is a review of studies concerning engine product odors. The author presents this review within the context of all combustion of hydrocarbon materials.

Jacobs, Morris B. "Recommended Standard Method for Continuing Air Monitoring for Hydrogen Sulfide Ultramicrodetermination of Sulfides in the Air," Journal of the Air Pollution Control Association, XV, No. 7 (July, 1965), 314-315.

A discussion of the methylene blue method for estimating the concentration of trapped sulfides is presented. A colorimetric method and a spectrophotometric method are described.

Johnson, Kenneth D. "Odorant Sources in Air Pollution." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

This paper provides a general overview of odorant sources.

Johnston, James W., Jr. "Organoleptic Analyses of Putrid Olfactory Stimuli," Psychonomatic Bulletin, I (1967), 9.

Significance of results obtained when several putrid smelling compounds are reacted in oxidents and heavy metal sets in aqueous solution in order to destroy or alter the quality are discussed.

________, and Rubacky, Eugene P. "Sensory Measurements of a Hedonic Tone and Odor Quality." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

The authors explain a scalar technique employing a panel of 10 to 15 judges to acquire specific, technical data for the evaluation of atmospheric and source odors.

Jones, F. Norvell. "A Comparison of the Methods of Olfactory Stimulation: Blasting vs. Sniffing," American Journal of Psychology, LXVIII (September, 1955), 486.

A discussion of the controlled blast method and sniffing for the collection of threshold data is presented. It is suggested that additional research is called for before both methods can be considered to have the same meaning.

———. "Scales of Subjective Intensity for Odors of Diverse Chemical Nature," American Journal of Psychology, LXXI (March, 1958), 305-310.

The subjective intensities of N-butanol, sec-butanol, iso-butanol, ethyl acetate, cyclohexane, and pyridine were scaled by the method of magnitude estimation. The resultsof this study showed that there is no evidence for a different stimulus-receptor interaction for polar as compared to non-polar substances.

———. "The Forced-Choice Method of Limits," American Journal of Psychology, LXIX (December, 1956), 672.

The forced-choice method of limits, a modification of the indirectional method of limits technique of determining olfactory thresholds, is discussed.

———. "The Reliability of Olfactory Thresholds Obtained By Sniffing," American Journal of Psychology, LXVIII (June, 1955), 289.

A discussion of a study designed to determine if sniffing is a reliable method for determining thresholds of different odorants is provided. This study determined that sniffing is an adequate technique.

———, and Woskow, Morris H. "On the Intensity of Odor Mixtures," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 484-494.

This article discusses experiments and results of a study designed to determine the interactions between pairs of odors above the threshold levels.

Kendall, David A., and Neilson, Anne J. "Correlation of Subjective and Objective Odor Responses," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 567-575.

Results of tests on a range of concentrations of four odorants in two media with an expert odor panel and gas-liquid chromatography are presented. Comparative data on odor threshold concentrations, changes in odor characteristics, and intensity produced by normal contaminants present in the odorants and by known mixtures of the odorants are also provided.

Leonardos, G., Kendall, D., and Barnard, N. "Odor Thresholds Determinations of 53 Odorant Chemicals," Journal of the Air Pollution Control Association, XIX (February, 1969), 91-95.

In order to assist in assessing potential odor problems arising from chemical manufacturing operations, the odor thresholds of 53 commercially important odorant chemicals were determined using a standardized and defined procedure.

Lindvall, Thomas. "Sensory Evaluation of Odor Intensity at the Source and in the Ambient Air." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

This paper discusses the aims of environmental hygienic evaluations of odorous air pollutants, requirements for the procedure used, and equipment and methods for sensory source strength analysis.

________. "Sensory Evaluation of Odors in the Ambient Air." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

Sensory methodology for ambient air analysis is discussed, including the following topics: equipment, sensory methods, and sensory evaluation in the ambient air.

Lyshkow, Norman A. "The Continuous Analysis of Sulfur Dioxide in Gaseous Samples," *Journal of the Air Pollution Control Association*, XVII, No. 10 (October, 1967), 687-689.

A technical discussion of the achievement of the stability required for the continuous analysis of sulfur dioxide by a reagent is presented.

Mateson, J. F. "Olfactometry: Its Technique and Apparatus," *Journal of the Air Pollution Control Association*, VI (November, 1955), 167-170.

A short review and classification of odor measurement devices is presented. New devices being developed are described, and factors effecting organoleptic odor determinations are outlined.

McGinnity, J. L., Grimley, K. W., Jr., Horres, C. R., Jr., and Mulik, J. D. "Mobile Source Sampling Laboratory for the Pulp and Paper Industry." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

This paper discusses a mobile source-sampling laboratory designed to be employed in the source testing program of a study for the pulp and paper industries in the United States.

"Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air." Report of an International Symposium in Stockholm, June 1-5, 1970.

This report is a result of discussions during a recent technical symposium. The report represents the consensus of the opinions of the participants and covers the evaluation of odorous air pollutants, effects of such pollutants, and recommendations for future research.

Mills, John L, Walsh, Robert T., Luedtke, Karl D., and Smith, Lewis K. "Quantitative Odor Measurement," *Journal of the Air Pollution Control Association*, XIII (October, 1963), 467-475.

Modifications to the ASTM odor measurement method are described. Methods for controlling odors in certain industries are discussed.

Montgomery, T. L., and Corn, M. "Adherence of Sulfur Dioxide Concentrations in the Vicinity of a Steam Plant to Plume Dispersion Models," Journal of the Air Pollution Control Association, XVII, No. 8 (August, 1967), 512-517.

A technical explanation of the present dispersion models concerning their varibility in predicting concentrations of SO_2 is presented. The study suggests that present dispersion models should be used only when predicting maximum concentrations under specific meteorological conditions.

Munn, R. E., and Stewart, I. M. "The Use of Meteorological Towers in Urban Air Pollution Programs," Journal of the Air Pollution Control Association, XVII, No. 2 (February, 1967), 98-101.

This paper provides a discussion of the relevance and application of data from the use of meteorological towers in the study of air pollution.

Nickol, G. B. "Rank Odor Method for Evaluating Stack Gases," Journal of the Air Pollution Control Association, LVIII (May, 1957), 55.

A simple, reliable procedure for evaluating stack gases is discussed.

Nolan, Philip. "Present-Day Limits on Infrared Absorption Techniques in Measurement of Odor," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 576-582.

This paper describes the limits of performance in determining trace concentrations of organic impurities in both large and small volumes of normal air.

Panghorn, R. M., Berg, H. W., Roessler, E. B., and Welsh, A. D. "Influence of Methodology on Olfactory Response," Perceptual and Motor Skills, XVIII (February, 1964), 91-103.

The odor of 2-heptanone was delivered by a precision olfactometer to subjects using five methods of single-sample presentation of concentrations. These methods and specific modifications of the constant-stimulus method are discussed.

Reese, T. S., and Stevens, S. S. "Subjective Intensity of Coffee Odor," *American Journal of Psychology,* LXXIII (September, 1960), 424-428.

The aim of this study was to develop a method of presenting controlled olfactory stimuli derived from natural coffee. It also was designed to attempt to determine how the subjective intensity of the odor grows with stimulus-concentration.

Rosen, A. A., Peter, J. B., and Middleton, F. M. "Odor Thresholds of Mixed Organic Chemicals," *Journal of the Water Pollution Control Federation.* XXXIV (January, 1962), 7-14.

Results of a series of experiments on the odor thresholds of some chemicals and a discussion of odor synergism are presented.

________, Skeel, R. T., and Ettinger, M. B. "Relationship of River Water Odor to Specific Organic Contaminants," *Journal of the Water Pollution Control Federation*, XXXV (June, 1963), 777-782.

This report describes the results of odor tests conducted in conjunction with a study of organic contaminants. The phenomenon of odor synergism was demonstrated in the polluted river that was tested.

Rumsey, Donald W., and Cesta, Ramon P. "Odor Threshold Levels for UDMH and NO_2." *American Industrial Hygiene Association Journal*, XXXI, No. 3 (May-June, 1970), 339-343.

This report discusses seven years of field experience that indicated that the actual threshold levels for unsymmetrical dimethylhydrazine (UMDH) and nitrogen dioxide are considerably lower than those generally quoted.

Schiff, William, and Thayer, Stephen. "Cognitive and Affective Factors in Temporal Experience: Anticipated or Experienced Pleasant and Unpleasant Sensory Events." *Perceptual and Motor Skills*, XXVI (May, 1968), 799-808.

A discussion of a study where subjects reproduced and verbally estimated short or long durations under conditions of smelling or anticipating smelling a pleasant, unpleasant, or neutral substance.

Schutz, Howard G. "A Matching-Standards Method for Characterizing Odor Qualities," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 517-526.

The results of a study showing that a matching-standards technique for describing the qualitative aspects of an odor is a reliable and valid method are presented.

Skinner, C. F. "Odor Control," National Engineer, LXXIV, No. 7 (July, 1970), 12-14.

A dilution method using the human nose to measure odor concentration and catalytic and thermal incineration systems are discussed.

Stone, Herbert. "Behavioral Aspects of Absolute and Differential Olfactory Sensitivity," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 527-534.

Results of studies conducted to test Weber's law and to reevaluate Fechner's stimulus-response relationship are presented. Evaluations of the olfactometer are also presented.

________, Ough, C. S., and Panghorn, R. M. "Determination of Odor Difference Thresholds," Journal of Food and Science, XXVII (1962), 197-202.

A modified olfactometer was used to determine odor difference thresholds at four levels of 2-heptanone. The apparatus was found to give rapid and reproducible threshold measurements.

Straforelli, J. B., Paszner, L., and Wilson, J. W. "Radiolysis of Kraft Mill Gaseous Effluents." Preprint, Canadian Pulp and Paper Association, Technical Section, and Chemical Institute of Canada (1970), 57.

Gas chromatographic studies of radiolytic effects of atomic radiation from a cobalt source on model compounds of kraft mill gaseous effluents are noted. An hypothesis for the process mechanism is suggested.

Stuiver, M. "An Olfactometer With a Wide Range of Possibilities," Acta Oto-Laryngologica, LI (January-February, 1960), 135-142.

An olfactorium which is very suitable for threshold measurements of the organ of smell is described. Rate of flow of odorous air, duration of stimulus, and number of odorous molecules are controlled independly.

Sullivan, D. C., Adams, D. F., and Young, F. A. "Design of an 'Odor Perception and Objectionability Threshold' Test Facility," Atmospheric Environment, II (March, 1968), 121-133.

The design requirements for the study of the thresholds of odor "perception" and "objectionability" in a large population of human subjects are discussed. Collection of data was facilitated by converting a bus into an air-conditioned, mobile odor perception laboratory.

Terabe, Moto J., Oomichi, Sadao, Benson, F. B., Newill, V. A., and Thompson, J. E. "Relationships Between Sulfur Dioxide Concentration Determined By the West-Gaeke and Electroconductivity Methods," Journal of the Air Pollution Control Association, XVII, No. 10 (October, 1967), 673-675.

Relationships between the sulfur dioxide concentrations determined by the West-Gaeke and electroconductivity methods are discussed. SO_2 concentrations determined by the electroconductivity method were greater, particularly in the winter season. The tests were held in Kawasaki, Japan, as a part of the United States-Japan Cooperative Air Pollution Measurement Studies.

Teranishi, Roy, Buttery, Ron G., and Mon, T. R. "Direct Vapor Analyses With Gas Chromatography," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 583-589.

Some of the problems encountered in detecting and recording food volatiles, the parameters which must be considered in order to utilize, the sensitivity possible with ionization detectors, and some examples of direct vapor sampling analyses are presented and discussed.

Turk, Amos. "Approaches to Sensory Odor Measurement," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 564-566.

A critical evaluation of the methods used to establish odor threshold values is presented. The article covers extrapolation of dilutions ratios, analysis of odorant solutions, tracer methods, and presentation of odor stimuli to subjects.

________. "Odor Source Inventories." Symposium on Odor Control, Sixty-Seventh National Meeting, Atlanta, Georgia, February 15-18, 1970.

Several methods used to compile odor source inventories are reviewed and discussed in detail. A procedure for translating quality descriptions into inventories of odor sources is presented.

________. "Problems in Sampling and Storing Stack Gases for Chemical and Sensory Analysis." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

Since stack gases are usually too hot and/or concentrated for direct presentation to people for sensory analysis, this paper considers the general problem of diluting odorants for sensory analysis as well as the various methods of sampling for chemical analysis.

________. "Properties of Odorants." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

This paper discusses odor sources that can be classified according to their degree of confinement, character or quality, hedonic impact, and persistence or pervasiveness in the atmosphere.

Ubaydullayev, R. "Atmospheric Air Pollution With Vapors of Hydrolytic Alcohol and Its Effect on the Organism," in *The Biological Effect and Hygienic Importance of Atmospheric Pollutants*, Book 10 (U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, 1968), XVII, 46-54.

This report presents the threshold of ethanol odor perception in most sensitive persons. Recommended minimum perceptible concentrations are presented.

Vogh, J. W. "Nature of Odor Components in Diesel Exhaust," *Journal of the Air Pollution Control Association*, XIX (October, 1969), 773-777.

The assessments of a human panel were used to determine odorant identity and quantitative contribution to exhaust odor.

Waller, R. A. "Environmental Quality, Its Measurement and Control," *Regional Studies*, IV (August, 1970), 177-191.

This paper summarizes techniques of environmental quality evaluation and recommends a method by which many diverse aspects of the environment, including odors, can be related to a common scale which, in turn, can have a monetary value attached to it.

Wilkens, Walter F., and Hartman, John D. "An Electronic Analog for the Olfactory Processes," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 608-612.

A discussion of refinements to an electrochemical device developed as a form of instrumentation for rapid and objective measurement of volatile flavors and other odors is provided.

Wohlers, Henry C. "Odor Intensity and Odor Travel From Industrial Sources," *International Journal of Air and Water Pollution*, VII (May, 1963), 71-78.

Odor surveys were completed of the stack effluents in the vicinity of a petroleum coking plant, a kraft paper mill, an onion and garlic dehydration plant, and a rotogravure printing plant. Extent of odor travel was compared with the calculated threshold dilution of the stack gases according to Sullivan's equation. Actual measurements did not always agree with calculated dilutions.

________. "Recommended Procedures for Measuring Odorous Contaminants in the Field," Journal of the Air Pollution Control Association, XVII, No. 9 (September, 1967), 609-613.

A description of generalized facts concerning odors is presented. Odorous measurement methods for individuals with a working knowledge of either odor or air pollution problems are discussed.

Wright, Robert Huey, and Michels, Kenneth M. "Evaluation of Far Infrared Relations to Odor by a Standards Similarity Method," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 535-551.

Results of a rigorous experiment evaluation of the relationship between odor and low-frequency molecular vibrations are presented. The method and chemical selection for the study were guided by the information found in a literature evaluation.

Yuldashev, T. "Toxicity of Ethylene Oxide in Low Concentrations," in The Biological Effects and Hygienic Importance of Atmospheric Pollutants, Book 10 (U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, 1968), XVII, 33-39.

This report presents the threshold of ethylene oxide odor perception in most sensitive test persons. Recommended minimum perceptible concentrations are presented.

D. ODOR ABATEMENT AND CONTROL TECHNOLOGY

Acres, G. J. K. "The Control of Air Pollution. Platinum Catalyst Systems for Industrial Odor Control," Platinum Metals Review, XV, No. 1 (January, 1971), 9-12.

A honeycomb catalytic system with heat recovery is schematically illustrated and discussed. The system has been successfully evaluated for the removal of odors from animal, fish, and food processing industries.

Barnebey, H. L. "Removal of Exhaust Odors From Solvent Extraction Operation By Activated Charcoal Adsorption," Journal of the Air Pollution Control Association, XV, No. 9 (September, 1965), 422.

A discussion of the method of operation used in the removal of isopropyl alcohol vapor from the air and the reuse of the recovered alcohol in the solvent extraction process is presented.

Bloomfield, Bernard D. "Costs, Efficiencies, and Unsolved Problems of Air Pollution Control Equipment," Journal of the Air Pollution Control Association, XVII, No. 1 (January, 1967), 28-32.

A detailed discussion of the cost of air cleaning equipment operational and performance problems is provided.

Bosworth, Cyrus M., and Barduhn, Allen J. "Recent Advances in Odor Control By Air Washing," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 638-651.

The historical and practical basis of odor removal by scrubbing air with liquids is considered. A merit factor system of evaluation is advanced for determining total operating costs of this method.

Bretcher, Hans. "Elimination of Malodorous Emissions in the Chemical Industry," Chemical Engineering, XLVI, No. 7 (September, 1968), 268-270.

Measures for control of malodorous emissions in the chemical industry are discussed. In addition, areas such as meteorology, chromatography, and process engineering methods are recommended for intensive future work in relation to such emissions.

Brewer, G. L. "Odor Control for Kettle Cooking," *Journal of the Air Pollution Control Association*, XIII (April, 1963), 167-169.

This paper discusses the odor problem of the paint and varnish industry, and explains the catalytic system of odor control.

Brooman, David L., and Edgerly, Edward J. "Concentration and Recovery of Atmospheric Odor Pollutants Using Activated Carbon," *Journal of the Air Pollution Control Association*, XVI (January, 1966), 25-38.

Results of a series of removal studies using activated carbon filters are presented. These studies indicated that the filter capacity is dependent on the type of carbon employed and the particular odor compound absorbed.

Byrd, J. F., Mills, H. A., Schellhose, C. H., and Stokes, H. E. "Solving a Major Odor Problem in a Chemical Process," *Journal of the Air Pollution Control Association*, XIV (December, 1964), 509.

This paper describes the control of a highly objectionable odor from a chemical raw material to be used in synthetic detergents. It also provides some guidelines for odor control in a complex process.

Chass, Robert L., Kanter, Carl V., and Elliott, Jack H. "Contribution of Solvents to Air Pollution and Methods for Controlling Their Emissions," *Journal of the Air Pollution Control Association*, XIII, No. 2 (February, 1963), 64-71.

A general discussion of solvent injection into the air over Los Angeles County and procedures for its control are presented. Control by adsorption was selected for the experimental work.

Douglass, Irwin B. "Some Chemical Aspects of Kraft Odor Control," *Journal of the Air Pollution Control Association*, XVIII (August, 1968), 541-544.

The principal sources of odor in the kraft pulping process, methods of control, and the chemistry of various control measures are discussed.

Fink, R. H. "A Management Approach to Odor Control," *Journal of the Air Pollution Control Association*, LVIII (May, 1957), 57-58.

Fundamental key steps for management's approach to odor control, regardless of the industry or company, are provided.

Fohl, Timothy. "Optimization of Flow for Forcing Stack Wastes to High Altitudes," *Journal of the Air Pollution Control Association*, XVII, No. 11 (November, 1967), 730-732.

This article discusses a procedure of waste gas projection to relatively high altitudes. By this method, pollution products are then carried to regions of low population density.

Gommi, J. V. "Design and Operation of Ace System for Kraft Odor Reduction," *Paper Trade Journal*, CLIV (July 6, 1970), 44-46.

Pilot development and the first commercially installed air contact evaporator system which eliminates the kraft recovery furnace contribution to total reduced sulfur emission are discussed.

Hanna, G. F., Kuehner, R. L., Karne, J. D., and Garbowicz, R. "A Chemical Method for Odor Control," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 663-675.

An air deodorant substance using potassium permanganate in combination with activated substances is described.

Hansen, G. A. "Odor and Fallout Control in a Kraft Pulp Mill," *Journal of the Air Pollution Control Association*, XII (September, 1962), 409-413.

The scope of the kraft mill pollution problem is discussed and the odor control methods used by one company are presented.

Hein, Glen M. "Odor Control by Catalytic and High-Temperature Oxidation," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 656-662.

This paper describes direct-flame and catalytic combustion as applied to odor control, and discusses operating costs and new developments.

Henshow, T. B. "Odor Control at a 2, 4-D Production Plant," Journal of the Air Pollution Control Association, XV, No. 11 (November, 1965), 516-518.

This article presents a discussion of the Chipman Chemical Company's system of fume collection and caustic soda solution scrubbing for the removal of phenolic compounds in plant exhaust air. The development, present status, and projected future improvements of this system of odor control are discussed.

Herrick, Robert A. "A Baghouse Test Program for Oxygen Lanced Open Hearth Fume Control," Journal of the Air Pollution Control Association, XIII, No. 1 (January, 1963), 28-32.

A discussion of a pilot study of a baghouse type dust collector to determine its possible merit in the control of pollution from an oxygen lanced open hearth furnace is presented. The results indicated a positive collection of iron oxide fumes.

Ito, Shozo. "No Pollution or Catalyst In Continuous Oil Gasification," Chemical Engineering, LXXVIII (December, 1970), 113-115.

A Japanese steam reforming technique which does not require a catalyst or carbon monoxide converter is described. A typical analysis of product gas is given.

Japikse, B. "Threshold Approach to Estimating Adsorber Performance," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 652-655.

An approach to estimating performance of activated charcoal adsorber cells used in air purification based on the concept of odor thresholds is advanced.

Jones, K. H., Thomas, J. F., and Brink, D. L. "Control of Malodors From Kraft Recovery Operations by Pyrolysis," Journal of the Air Pollution Control Association, XIX (July, 1969), 501-504.

A simplified odor model is presented, which establishes the constraints which must be placed on the combustion phase of the recovery operation of kraft mills in order that emission concentrations are kept below their threshold odor levels.

Kellum, James. "Sewer Odor Control," *Water and Waste Engineering*, VII, No. 7 (July, 1970), 43.

Advantages and equipment for a newly developed process for the control of odors in sewers, lift stations, and sewage treatment plants is discussed.

Kulka, Kurt. "Odor Control By Modification," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 676-681.

This paper is concerned with air freshening in confined spaces.

Larsen, Ralph I. "Determining Reduced Emissions Goals Needed to Achieve Air Quality Goals: A Hypothetical Case," *Journal of the Air Pollution Control Association*, XVII, No. 12 (December, 1967), 823-828.

Discussion and explanation of a hypothetical case for the determination of a set of reduced emission goals for stationary and mobile combustion sources is provided.

Moorman, Robert, Jr. "Controlling Odors From Cattle Feed Lots and Manure Dehydration Operations," *Journal of the Air Pollution Control Association*, XV (January, 1965), 34-35.

A study of various types of odor control measures observed from inspections of cattle feeding lots across the country is discussed. The dehydration method for storing manure prior to its dehydration is described.

Nelson, F., and Shenfeld, L. "Economics, Engineering and Air Pollution in the Design of Large Chimneys," *Journal of the Air Pollution Control Association*, XV, No. 11 (November, 1965), 536-538.

A description of the method for chimney selection and design is provided. A reduction in SO_2 was observed due to large mass flow from a single source and buoyancy effect.

Ottoson, David G. R. "Maintenance of Odor-Control Systems," *Environmental Control Management* (1970), 58-59.

To prevent odor during fermentation from being vented into the atmosphere, engineers at a pharmaceutical company producing antibiotics devised a system for conducting the fumes of the fermentation facilities to the power plant for incineration. This system is discussed.

Persson, Goran A. "Odour and Air Quality Management. Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

This paper reviews some of the air pollution problems caused by odors; hygienic, sanitary, and technological standards for air quality; practical use of odor measurements; and some problems and questions for further study.

"Pollution Control Progress," *Journal of the Air Pollution Control Association*, XVII, No. 3 (March, 1967), 172-174.

A discussion of the active steps being taken by individual corporations and individual plants in the battle against air pollution is presented.

Roberson, James E. "The Effect of Odor Control On a Kraft Mill Energy Balance," *Journal of the Air Pollution Control Association*, XX (June, 1970), 373-376.

Thirteen different recovery unit odor control cases are analyzed to determine the variation in energy costs. Control methods such as oxidation and new recovery systems are compared for a new 600 ton/day kraft pulp mill.

Rowe, Norman R. "Odor Control With Activated Charcoal," *Journal of the Air Pollution Control Association*, XIII (April, 1963), 150-153.

A discussion of effective, activated charcoal, odor-control systems is presented.

Ryason, P. R., and Harkins, J. "Studies On a New Method of Simultaneously Removing Sulfur Dioxide and Oxides of Nitrogen From Combustion Gases," Journal of the Air Pollution Control Association, XVII, No. 12 (December, 1967), 796-799.

A substantial reduction of sulfur compounds and oxides of nitrogen in flue gases is possible by catalyzed reaction with carbon monoxide. The economics of this process are estimated to be similar to those of the catalytic oxidation process.

Stern, Arthur C. "Summary of the Conference on Odor Control," Journal of the Air Pollution Control Association, LVIII (May, 1957), 53-84.

This paper summarizes the information presented at the Symposium on Odor Evaluation and Odor Control, Cincinnati, Ohio, October 25, 1956.

Strauss, W. "The Development of a Condenser for Odor Control From Dry Rendering Plants," Journal of the Air Pollution Control Association, XIV (October, 1964), 424-426.

This paper discusses a surface condenser and carbon absorber which provides an economic solution to the problem of odors from dry rendering plants.

Sullivan, J. L., Kafka, F. L., and Ferrari, L. M. "An Evaluation of Catalytic and Direct Fired Afterburners for Coffee and Chicory Roasting Odors," Journal of the Air Pollution Control Association, XV, No. 12 (December, 1965), 583-586.

This paper discusses a method of using thermal afterburners in the reduction of odor from large scale plants. Where high cost of fuel prohibited the use of thermal afterburners, catalytic combustion was used as an alternative.

Sweeney, Patrick M. "Exhaust Control Devices," Journal of the Air Pollution Control Association, XV, No. 1 (January, 1965), 13-14.

This article summarizes the developments in the area of exhaust control up to 1965.

Teller, A. J. "Odor Abatement in the Rendering and Allied Industries," Journal of the Air Pollution Control Association, XIII (April, 1963), 148-149.

A review of operational odor abatement systems designed for the three different types of rendering operations is presented.

Tucker, W. Gene. "Odor Control Technology in the Wood Pulping Industry." Paper presented at the Conference on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, June 1-5, 1970.

The approximate limiting capability of present odor control technology for kraft pulp mills is discussed in terms of minimum overall emissions of total reduced sulfur compounds. Costs of such control are estimated, maximum ambient ground level concentrations are calculated, and factors in determining the types of odor control research and development that should be undertaken in the future are discussed.

Turk, Amos. "Odor Control," Encyclopedia of Chemical Technology, XIV (New York: John Wiley & Sons, Inc., 1967), 170-178.

This article reviews the various methods of odor control and gives some consideration to the relative effectiveness and cost of these methods.

Vedernickov, V. G., and Maksimov, V. F. "Some Problems in the Deodorization of Gas Discharges in the Sulfate-Cellulose Industry." (Franklin Institute Research Laboratories, Philadelphia, Pennsylvania, Science Information Services, November 11, 1969).

This article discusses the use of uncondensed exhaust gases and deodorizing agents for the sulfate-cellulose industry.

Viessman, Warren. "Ventilation Control of Odor," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 630-637.

This article includes a discussion of odors, odor sources, and ventilation as a means of odor control.

Walker, A. B. "Operating Principles of Air Pollution Control Equipment. Guidelines for Their Application," Proceedings of the MeCAR Symposium, Design and Operation for Air Pollution Control (American Institute of Chemical Engineers, New York, New York, 1968), 49-74.

The basic operating principles of equipment for emission control are examined and the critical factors in their application are identified.

E. ODOR CONTROL ORDINANCES

Barth, D. S. "Administrative Mechanisms Available for Control of Odorous Compounds Under the U. S. Clean Air Act, As Amended." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

Some of the authorities granted to the Administrator, Environmental Protection Agency, by the amended Clean Air Act are discussed in terms of their possible applicability to the control of odorous compounds.

Barynin, Jan. "Measuring Odour Pollution," New Scientist, XLVIII, No. 723 (October 15, 1970), 116-119.

The prospects of introducing scientific standards for assessing odor pollution as an aid towards legislation on odor abatement are discussed. Comparison of the photomultiplier tube and observer responses are also considered.

Bistowish, Joseph M. "Nashville's Air Pollution Problem: Past, Present, and Future." Vanderbilt University, Nashville, Tennessee, School of Engineering, Tennessee Stream Pollution Control Board, Tennessee Department of Public Health, Proc. Conf. Environ., Water Resources Engineering, 85th Anniversary, Nashville, Tennessee, 1969, 171-177.

The provisions and implementation of an air pollution control ordinance prepared by the Nashville Department of Health, including provisions for odor pollution control, are discussed.

"Control of Air Pollution," International Digest of Health Legislation, XX, No. 3 (1969), 418-419.

The principal provisions of a regulation under an air pollution control act for Ontario are presented. The regulation states that equipment may not be operated which does not comply with minimum air quality standards or emits disagreeable odors. Maximum allowable concentrations for use in assessing air quality are also prescribed.

Cross, Frank L., Jr., and Ross, Roger W. "Current Status of Air Pollution Control Regulations for Asphalt Plants and Similar Drying Operations." Preprint, Public Health Service, Durham, North Carolina, National Air Pollution Control Administration, September, 1969.

Current regulations for controlling emissions from asphalt plants are reported for 38 states and 6 local agencies. Nine states employ a standard for odor control. Most of the odor regulations are general in nature, although one state stipulates the use of a scentometer for odor measurement.

First, M. W. "A Model Odor Control Ordinance." Paper presented at the Second International Clean Air Congress of the International Union of Air Pollution Prevention Associations, Washington, D. C., December 6-11, 1970.

A discussion of the current pollution regulations concerned with odor, odor perception and evaluation, and odor nuisance evaluation is provided along with a model odor control ordinance that provides a numerical method for arriving at an objective judgment of the degree of nuisance associated with a particular set of conditions.

Gruber, Charles W. "Odor Pollution Problems From the Control Officials' Viewpoint," *Journal of the Air Pollution Control Association*, LVIII (May, 1957), 56-57.

A discussion of odor pollution from the control officials' point of view is provided. Topics included are: Finding the Odor Source, Evaluating the Odor Situation, What Can Be Done About an Odor Situation, and Odor Monitoring Runs.

Jonsson, Erland. "Nuisance From External Environmental Factors and Norms for Their Evaluation," *Nordisk Hygienisk Tidskrift*, XLIV (1963), 69-84.

A summary of the background and results of four studies on problems connected with the decisions about the presence of "sanitary nuisance" is given. Suggestions are made for measures which would increase the likelihood of correct and well-founded decisions being made as to the presence of a "sanitary nuisance."

Larsen, Ralph I. "Relating Air Pollutant Effects to Concentration and Control." National Air Pollution Control Administration, Durham, North Carolina, Office of Criteria and Standards, 1969.

Examples are cited relating air pollutant effects to concentration and control. The examples are organized into a dozen possible steps that could be used to proceed from air quality criteria to clean air.

Lindemann, E. H. "Odor Control — 1953," *Annals of the New York Academy of Sciences*, CXVI, Art. 2 (July, 1964), 623-629.

The state of the art of odor control in 1953 is surveyed. Methods of eliminating odors by mechanical or physical means, chemical means, and by masking or modification are presented. An extensive bibliography of the literature on the subject in the late 1940's and early 1950's is also presented.

Stumph, Terry L., and Duprey, Robert L. "Trends in Air Pollution Control Regulations," *Environmental Control Management*, CXXXIX, No. 2 (February, 1960), 45-46.

Some existing odor control regulations and their partially successful measures are discussed. Possible developments in control regulations are also presented.

"Summary of Air Pollution Actions in 1966 State Legislatures," *Journal of the Air Pollution Control Association*, XVII, No. 2 (February, 1967), 115-118.

A brief analysis of the legislation concerning air pollution in 1966 is presented.

Turk, Amos. "A Basis for a Model Ordinance to Control Effectively Community Odor Problems." Report submitted to the U. S. Public Health Service, Contract No. PH 27-65-104, September 29, 1965.

This report provides a basis for a model ordinance and covers such topics as points of measurements, methods of measurements, allowable concentration limits, and experimental test programs necessary for the implementation of the methods suggested in the report.

Walsh, Robert T. "The Bishop Case — An Interstate Odor Problem." Preprint, National Air Pollution Control Administration, Durham, North Carolina, Division of Abatement, 1970.

A discussion of the technical evaluation, the abatement conference, recommended remedial measures, and ensuing public hearing against one company is presented. The company's failure to carry out the remedial measures led to a suit in the U. S. District Court in Maryland and the eventual order to shut the plant down.

F. GENERAL INFORMATION ON ODOR POLLUTION

Gonzalez, D. J. "Odor Problems: A Review," Annals of the New York Academy of Sciences, CXVI, Art. 2 (July, 1964), 621-622.

A brief review of some odor problems in the early 1950's is presented.

Research Triangle Institute, Research Triangle Park, North Carolina, Engineering and Environmental Sciences Division. Applications of Aerospace Technology in Air Pollution Control. Final Report. NASA Contract NSR-34-004-056, RTI UE-411-3, June, 1969.

This paper is a report of the work of the Technology Application Team of Research Triangle Institute which identifies very specific technology-related problems and prepares air and odor pollution problem abstracts which describe such problems in a concise manner using functional, nondisciplinary terminology.

Rose, A. H., Smith, R., McMichael, W. F., and Kruse, R. E. "Comparisons of Auto Exhaust Emissions in Two Major Cities," Journal of the Air Pollution Control Association, XV, No. 8 (August, 1965), 362-366.

A detailed discussion of the comparison of auto exhaust in a low-altitude city to auto exhaust in a high-altitude city is presented.

Sullivan, Ralph J. "Preliminary Air Pollution Survey of Odorous Compounds." A Literature Review. Litton Systems, Inc., Silver Springs, Maryland, Environmental Systems Division, Contract PH 22-68-25, NAPCA Publ. APTP 66-42, October, 1969.

A review of the literature concerning the effects, sources, abatement methods, and detectors of odorous pollutants is presented.

Suzuki, Takeo. "Summary of the Problems in Odorous Air Pollution in Japan." Paper presented at the working conference on The Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, a symposium sponsored by the Environmental Protection Agency, Air Pollution Control Office, Cambridge, Massachusetts, April 26-27, 1971.

This paper reviews the odor problem in Japan and covers such topics as features of the odor problem, major malodorous compounds and their sources, reactions of the people against odor, and odor control.

PROCEDURE MANUAL

PROCEDURES FOR THE IDENTIFICATION AND ASSESSMENT COMMUNITY ODOR PROBLEMS

Prepared for the

ENVIRONMENTAL PROTECTION AGENCY
Under Contract No. CPA 70-116

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November 1971

ACKNOWLEDGMENTS

Copley International Corporation gratefully acknowledges the cooperation of many private citizens who gave generously of their time by participating in personal interviews. Without their wholehearted cooperation, this manual would not have been possible. Copley International Corporation is especially grateful to Mr. Richard C. Dickerson of the Environmental Protection Agency for his counsel and assistance in the development of this document.

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IDENTIFICATION AND ASSESSMENT OF COMMUNITY ODOR PROBLEMS

INTRODUCTION

The procedures described in this manual are designed to assist governmental agencies in dealings with community odor problems caused, particularly, by industrial operations. The procedures are addressed to "local" agencies since the investigation of community odor problems usually occurs within the public health departments or air quality offices of local government. They are, however, equally applicable to the needs of state agencies operating at the local level.

BACKGROUND INFORMATION

The contents of this manual were developed primarily from the results of two studies — the national survey of the odor problem, conducted in 1969, and a study of the social and economic impact of odors, conducted in 1970 and 1971. Both were conducted by Copley International Corporation for the Environmental Protection Agency. Secondarily, the contents evolved from the findings of other research done in the United States and Sweden, and from the opinions of scientists, jurists, and many local agency officials. The procedures represent a logical sequence of investigation from problem identification and source verification to a promise of uncomplicated methods of social and economic assessment.

The difficulty with the investigation of community odor problems lies in the lack of objective evidence that such problems exist. Analytical equipment is available to measure low concentrations of a few odorous substances, but even in situations involving such substances, there is no way to translate known concentrations into odor intensities. Equally distressing, there is no way to translate known odor intensities into an index of problem perception. Thus, for the present at least, reliance must be placed on personal evaluation by the normal or ordinary person in the community.

Traditional methods for solving community odor problems include the presentation of subjective evidence to the courts for consideration under public nuisance law, which, for remedy, requires substantial and unreasonable interference to the normal person in the community. The most widely used form of such evidence has been complaints initiated by residents. On the surface, it would seem that such evidence must define the existence of a problem. Yet, under a literal interpretation of public nuisance law, it may not. It is seldom determined from complaints whether the complainants, individually or as a group, actually represent the ordinary person or whether the ordinary person has suffered interference.

The procedures described in this manual are offered for use in connection with public nuisance law in lieu of counting complaints or attempting to extract meaningful information from complainants' remarks. Within these procedures, complaints are relegated to a proper function of alerting local authorities to the locations of possible odor problems.

Problem Identification Based on Public Attitude Surveys

The most direct means of identifying community odor problems is an attitude survey. This stems from the personal nature of odor evaluation and the concept that attitudes reflect personal evaluations. Unlike odor complaints, an attitude survey of a randomly selected sample of residents would satisfy public nuisance law. The random sample would represent the normal person. Attitudes expressing annoyance (typical in odor cases) would represent interference.

To determine whether interference is substantial and unreasonable creates a complexity. Equity is involved. It is unfair to find substantial and unreasonable interference on the basis of an arbitrary percentage of residents who express annoyance. Recent studies have found that, even in virtually odor free areas, up to 50 percent of the residents may express annoyance to odors. This is due to a variety of factors including, for example, residents with unusual sensitivity to background odors, feelings against nearby industry, and neurosis.

The procedure for problem identification provides an equitable basis for showing the extent of interference suffered. It is assumed that the percentage of residents who would express annoyance to odors when odors are not present is approximately equal in all communities of similar socioeconomic characteristics in a particular metropolitan area. (Once established for communities of similar socioeconomic characteristics, the percentages must not be applied to communities of other characteristics in the same metropolitan area or to communities of similar characteristics in other metropolitan areas. This assumption is supported by the results of the study of the social and economic impact of odors.) It is also assumed that residents of all communities have equal right to odor free air. By comparing the results of identical attitude surveys conducted in a suspected odor problem community and a similar, but odor free community, it can be statistically determined if a greater percentage of residents in the former area express annoyance. If so, an odor problem is identified and an equitable basis for showing substantial and unreasonable interference is provided.

Source Verification Based on Sensory Techniques

Whenever an odor problem has been identified, the source of the odors must be found if the problem is to be remedied. When odors are experienced in a community frequently or over long duration, it is common for the residents to know or at least suspect the source. Still, the source must be verified by local authorities.

Source verification is a straightforward endeavor when the odor is easily recognized and only one source capable of causing such an odor is located near the problem community. In such cases, a simple investigation is adequate. However, when the odor is not familiar or occurs downwind of more than one possible source, the specific offender may be difficult to pinpoint. To deal efficiently with such cases, the use of sensory techniques must be considered. The procedure for source verification describes two of the most successful techniques — one featuring immediate availability, the other, depth of evaluation.

The use of sensory techniques in problem identification may be possible in the future. This alternative to the use of public attitude surveys may save time (including the time of residents who would otherwise be interviewed) and expense without much loss of confidence in the results. What is needed to examine this possibility is concurrent use of the sensory techniques and public attitude surveys recommended by this manual on numerous occasions over time.

Based on the outcome of field tests performed by its developers, the scentometer is recommended for indicating the locations of possible odor problems during routine surveillance. A condition for its use in this capacity is given in a following paragraph.

Problem Assessment

By problem assessment is meant a determination of economic and social impact of odors on a community. Such information would support, but not replace the need for problem identification in odor cases. Tentative methods of problem assessment have been developed, the most comprehensive of which are documented in the final report of the social and economic impact study. However, because they are not yet refined to the level of problem identification and source verification and because they require highly specialized social science skills not possessed by most local agencies, they are not included in this manual.

CONDITIONS WARRANTING USE OF THE PROCEDURES

Two types of odor situations may exist in a community. One may lead to an odor problem; the other does not. They are referred to as acute episodes and chronic situations and are distinguished under public nuisance law, which is not concerned with occasional causation of odors. For purposes of the following definitions, causation of odors is meant to infer continued emission of odorous substances into the atmosphere, not merely a result of impaired atmospheric dilution capacity.

Acute Episodes

An acute episode is defined as a causation of odors beyond the property limits of a source, occurring no more than once and lasting no more than one day in any three month period. An acute episode involving the emission of measurable concentrations of odorous substances into the atmosphere should be dealt with as a possible infraction of the air quality standards governing such substances. An acute episode should *not* be considered as a possible odor problem regardless of the characteristics of the odors caused.

Chronic Situations

A chronic situation is defined as a causation of odors beyond the property limits of a source occurring more than once or lasting more than one day in any three month period. A chronic situation involving the emission of measurable concentrations of odorous substances should be dealt with as a possible infraction of the air quality standards governing such substances. *A chronic situation should be considered as a possible odor problem under any of the following conditions:*

(1) If one or more odor complaints are initiated by residents of a community and verified by local authorities after the first day of the first occurrence in any three month period.

(2) If twenty or more odor complaints are initiated by residents of a community, but not verified by local authorities after the first day of the first occurrence in any three month period.

(3) During routine surveillance by local authorities when traveling through a community, if odors are detected on more than one day in any three month period. Such odors must be of sufficient intensity to be detected using a Barnebey-Cheney Model I-3 Scentometer set at 7 dilutions to threshold.

The existence of a chronic situation and any of these conditions should be necessary and sufficient for the employment of the following procedures.

PROCEDURE FOR PROBLEM IDENTIFICATION BASED ON BRIEF PUBLIC ATTITUDE SURVEYS

INTRODUCTION

The following procedure is designed to allow local agencies to conduct, with their own personnel, public attitude surveys to identify community odor problems. If sufficient funds are available to the local agency, a professional interviewing or survey firm could be engaged to perform many of the tasks described in this procedure. However, the additional expense is not necessary if the procedure outlined is followed with care by local agency personnel. It is important to note that failure to adhere to the procedure could lead to survey results that are misleading or meaningless.

Before describing the detailed steps to be undertaken in conducting a public attitude survey, it may be helpful to summarize the major tasks to be completed. These tasks are described in general terms below.

This survey is designed to compare the attitudes of people residing in a community thought to be an odor problem area with attitudes of similar people residing in an odor free area. Attitudes of both groups are determined by conducting interviews by telephone with residents of both areas. (Tasks followed by an asterisk (*) could be done by an interviewing firm.)

(1) The first task is to define the possible odor problem area.

(2) Next, a matching odor free area is located.

(3) Utilizing a street address (reverse order) telephone directory, a list of telephone numbers in each area is made, and a sample of these telephone numbers is selected at random.*

(4) Utilizing the questionnaire provided in this procedure, telephone interviews are conducted with the man or lady of the house for each telephone number included in the sample.*

(5) The total number of responses to key questions asked in both areas is then tabulated and compared for problem identification.

(6) Finally, if an odor problem is found, an odor problem index number is calculated.

WHEN TO USE PUBLIC ATTITUDE SURVEYS

A public attitude survey should be conducted only after any of the three conditions stated in the previous section of this procedure indicate the location of a possible odor problem.

SETTING UP TEST AND CONTROL AREAS

The community in which an odor problem is suspected is called the "test area." The first task to be undertaken is to define the preliminary geographic limits of the test area. This can be done by driving an automobile in a grid pattern throughout the general area, while noting the geographical boundaries within which the odor is perceived. Meteorological data indicating wind patterns can also be helpful in setting these boundaries, as can complaint patterns. It is necessary to establish a test area that has boundaries coincident with those of census tracts. If only a portion of a census tract is included in the preliminary boundaries of the test area, that census tract should not be used unless a large proportion of the entire census tract is probably affected by odors. It is important to include only those tracts where an odor problem is likely; otherwise, the results of the survey may not be conclusive.

Next, the socioeconomic characteristics of the test area must be determined. Using the latest U. S. Censuses of Population and Housing Census Tract Reports (PHC), list the following characteristics of the test area: median income for families, median value of owner occupied housing units, median gross rent of renter occupied units, median number of rooms, and year structure was built.

An odor free community must now be located that matches the test area as closely as possible. This community is called the "control area." The following criteria should be used in choosing the control area.

(1) The control area should be as odor free as possible. To ensure this, the local agency should not have received any odor complaints from residents of the area during the past year.

(2) The control area should be located within ten miles of the test area.

(3) The control area should have the same type of access to freeways or turnpikes as the test area.

(4) The control area should be located within approximately the same distance from commercial or industrial establishments as the test area.

(5) The median income, home value, gross rent, and age of structure (the latter must be figured from year structure was built) for the control area should not differ from that of the test area by more than 20 percent.

(6) Median rooms (per house) should not differ by more than 10 percent for any one category. For example, suppose the test area contains 646 housing units having five rooms out of a total of 2,332 housing units; then, 27.7% are in the five room category. Suppose the control area contains 375 units having five rooms out of 1,981 units; then, 18.9% of the units are in the five room category. For this example, the difference is 8.8% (27.7% - 18.9% = 8.8%), which is acceptable.

OBTAINING A SAMPLE

First, list all the streets in the census tract(s) that have been selected for the test area. Note the house number of the first and last house within the census tract(s) on each street that runs beyond the test area. Using a street address (reverse order) telephone directory, which can be obtained from the telephone company, count the total number of telephones that are listed for streets in the test area. In this count, do not include professional offices, commercial establishments, government offices, or industrial facilities. Next, using a table of random numbers, select one number that falls between the number "1" and the total number of telephones in the test area. Count from the first test area address in the directory to this number. This is the starting point, i.e., the first telephone number to be used for the sample. Refer to Table 1 to determine the number of telephone numbers to be passed over before a second telephone number is chosen (the sampling interval). Write down this address and telephone number. Continue in this manner until all telephone numbers in the test area have been written down or passed over as part of the sampling interval. It should be noted that if the starting point is toward the middle of the alphabetically listed streets in the directory, when the last street in the test area is reached, the sampling should be continued by returning to the first alphabetically listed street in the test area.

When this procedure has been completed for the test area, the same thing should be done for the control area.

Table 1. Sampling interval.

Number of Telephones in the Area	Sampling Interval
1 - 90	include all telephones
91 - 180	2
181 - 270	3
271 - 360	4
361 - 450	5
451 - 540	6
541 - 630	7
631 - 720	8
721 - 810	9
811 - 900	10
901 - 990	11
911 - 1080	12
1081 - 1170	13
1171 - 1260	14
1261 - 1350	15
1351 and over	16

CONDUCTING THE SURVEY

Each time interviews are conducted in the test area, they must also be conducted in a matching control area. This is necessary to permit the statistical comparisons required to verify the findings of the survey. Surveys should be conducted concurrently in the test and control areas. The same control area may be used for different test areas if the residents have the same socioeconomic characteristics as those in a second test area.

Telephone calls to administer the questionnaire should not be made before 9:00 a.m. nor after 9:00 p.m. To reduce the elapsed time needed to complete the telephone calls, the samples may be divided among two or more interviewers. If only two interviewers are used, one may be assigned to call the control area sample while the other calls the test area sample. To reduce the possibility of interviewers biasing the results of the survey, it is desirable to switch the interviewers about half way through the sample, i.e., after one-half of the telephone calls in the test area have been made by one interviewer, this person should make calls in the control area. The other interviewer will make the balance of the test area calls. A blank copy of the questionnaire will be needed for each telephone number to be called.

Pretesting the Survey

Because it is unlikely that local agency personnel are experienced in conducting telephone surveys, it will be of considerable help to pretest the survey.

However, the pretest results should not be combined with those of the actual survey.

Arrange for the persons who will conduct the telephone interviews to read the "Instructions for Interviewers" section of this procedure. When this has been done, have each interviewer go through the questionnaire asking the questions aloud of another agency employee. Note whether the interviewer is following instructions in every detail, and correct any errors in interviewing technique. Then, select at random five telephone numbers for each interviewer who will participate in the survey. These telephone numbers should be different from those chosen as part of either the test or control area samples. Have each interviewer call five numbers and administer the questionnaire. Again, note whether the interviewer is following instructions, and correct any errors. When each interviewer is thoroughly familiar with the questionnaire and interviewing technique, begin calling the telephone numbers in the test and control area samples.

Instructions for Interviewers

Because people would usually like to tell you what they believe you want to hear, it is important that the interviewer restrict what is said to the questions or comments on the questionnaire. If the interviewer engages in pleasantries or chats with the person answering the questions, the responses received may be different from those that would otherwise be obtained. The interviewer should be particularly careful not to indicate by either comment or tone of voice any reaction to the answers received. It is also important for the interviewer not to reveal the name of the agency conducting the survey nor the reason the survey is being conducted. Some respondents may challenge the interviewer or question the validity of the survey. Such situations must be handled with a great deal of tact on the part of the interviewer. The respondent has the right to determine whether the survey is legitimate, but if information about the agency or the survey is given before the questions are asked, the respondent's answers may not be valid. Therefore, if possible, the interviewer should agree to tell the respondent this information after the questionnaire is completed. If the respondent refuses to continue the interview without this information, the interview should be terminated.

The respondent may suspect that the call is being made in connection with the sale of a product. The interviewer may assure the respondent that this is not the case prior to asking the questions. It may also be necessary to tell the respondent that the answers given will become a part of a statistical summary and individual responses will not be revealed in any way. If required, this may also be done prior to asking the questions.

Never suggest an answer or train of thought to the respondent. Do not prompt in any way. The most important job of an interviewer is to encourage the respondent to express his or her attitudes freely and to be specific in conveying these attitudes. Close attention to the clarity and completeness of the responses is important. Never talk up or down to a respondent. Do not comment on the meaning of any question or indicate in any way what kind of answers are expected.

If the respondent asks a question or fails to understand or respond to a question, read the question over again more slowly, using a pleasant but neutral tone of voice. On occasion, it may be necessary to repeat a question more than once before obtaining a response. Do not allow any tone of impatience to creep into your voice.

When asking the questions, stress only those words that are underlined. Do not change the wording of any question. These questions have been carefully constructed to obtain the information desired. Do not change the order of the questions from that listed on the questionnaire.

Before making a telephone call, the interviewer should fill out the upper portion of the questionnaire (a copy of the questionnaire is included at the end of this procedure). From the sample listing, fill in the telephone number, street address, and city to which the call will be made. The "File No." blank is provided for identification of the odor source under investigation. This blank should not be filled in until the source has been verified. The "Survey No." blank is provided to allow differentiation between test and control area responses, as well as surveys conducted at a later time. For example, before the first survey of a suspected odor problem, "Survey No. 1" could be assigned to the test area and "Survey No. 2" could be assigned to the control area. If the same areas are the subject of another survey at a later date, survey numbers 3 and 4 could be assigned, respectively.

The "Respondent No." should be left blank until tabulation of the survey results is begun. However, the date of the call and the time of day the call is made should be noted on the questionnaire before the call is made.

Interviewer Instructions for Making Calls

Call the telephone number filled in on the questionnaire. If there is no answer or the line is busy, go on to the next telephone number on the list.

If the call is answered, read the opening statement, saying your name in the appropriate place. If the person who answers the telephone is obviously a woman, use the feminine alternatives in the statement; if a man, the masculine alternatives. Children, relatives, or friends living in or visiting the household should not be interviewed. In addition, no person under 18 years of age should be interviewed. Make sure that the person with whom you are speaking is the man or lady of the house. If he or she is not, try to talk with the man or lady of the house. If this cannot be done, terminate the call, check that the interview was not completed, note the reason, and go on to the next telephone number in the sample.

If the man or lady of the house refuses to be interviewed at all, note that the interview was not completed and the reason. "Refused" is a sufficient explanation.

The numbered blanks in the right-hand margin of the questionnaire are to be used in tabulating the responses. Do not write in these spaces at this time. Every question has a list of responses after it. Except for question 3, only one answer should be checked. If the respondent gives more than one answer for a question, ask which answer is the best answer to the question. When a question is followed by three periods, such as, "How strong would you say these odors smell? Would you say...?", read the answers provided in the order they are listed, but do not read either the answer numbers or the response "Don't know."

When a question is not followed by three periods, such as, "When was the last time you noticed odors in your neighborhood?", do not read the responses. In this case, simply check the answer that corresponds to the respondent's reply. When a question has a space provided for "Other answers," write down everything the respondent says. If local agency secretaries are used as interviewers, they should use only longhand to write down "Other answers."

Interview Instructions for Specific Questions

The following instructions should be adhered to in asking the specific questions on the questionnaire.

Question 1. Do not read the responses. If the respondent answers "No," read the statement following the "No" response and terminate the interview.

Question 2. Do not read the responses. If the respondent answers "Yes," ask question 3. If the respondent answers "No" or "Don't know," ask question 4.

Question 3. This question should be asked only of those people who answered "Yes" to question 2. Read the responses, except for "Don't know." Check all answers that the respondent gives to this question.

Question 4. Do not read the responses. If the respondent answers "No," or "Don't know," skip to question 12. If the respondent answers "Yes," ask question 5.

Question 5. Do not read the responses. Check the response that covers a period most like that identified by the respondent. Repeat the question, if necessary, to obtain a response, but do not read the possible responses.

Question 6. Do not read the responses. Check the response that covers a period most like that identified by the respondent. Repeat the question, if necessary, to obtain a response, but do not read the possible responses.

Question 7. Read the responses rather slowly, pausing between each possible response. Do not read "Don't know." Repeat the question and responses, if necessary, to obtain a reply.

Question 8. Do not read the responses. Check the response that covers a period most like that identified by the respondent. Repeat the question, if necessary, to obtain a response, but do not read the possible responses.

Question 9. Do not read the responses. If the respondent answers "No" or "Don't know," skip to question 11. If the respondent answers "Yes," ask question 10.

Question 10. Read the responses rather slowly, pausing between each possible response. Do not read "Don't know." Repeat the question and responses, if necessary, to obtain a reply.

Question 11. Do not read the responses. Clarify the response, if necessary, by asking the respondent to explain more fully what is meant by the answer given. For example, if the respondent says "Some factory," clarification might elicit the answer, "An oil refinery near my neighborhood." Write down other source(s) identified by the respondent.

Next, read the statement preceding question 12 regarding the confidential nature of the information being gathered.

Question 12. Do not read the responses. Clarify the responses, if necessary, as explained under question 11. Write down the other company mentioned by the respondent if the answer is not the source(s) under investigation.

Question 13. Do not read the responses. Clarify the response, if necessary, as explained under question 11. Write down the other companies or employers mentioned if the answer does not include the source(s) under investigation.

Interviewer Instructions for Completing Interviews

Read the statement at the end of the questionnaire and terminate the interview. Write your name in the space provided, and check the space for a completed interview on the first page of the questionnaire. Go on to the next telephone number.

Interviewing should be continued until all of the telephone numbers in the sample have been dialed once. Review the completed questionnaires, and remove those where the answer to either question 12 or question 13 indicates a member of the household is employed by the odor source under investigation. This is recommended because of potential bias the respondent may have either in favor of or against the employer. If the source has not been verified by an agency inspector, this step should be ignored.

Next, count the number of completed questionnaires remaining for the test area. If there are at least 30, the interviewing portion of the survey is complete. If not, continue to interview, utilizing those telephone numbers where no-answers or busy signals were received, until at least 30 questionnaires are completed or until all no-answers or busy signals in the sample have been called a second time. Do the same thing for the control area.

Tabulation

If the local agency has access to electronic data processing equipment, and the number of responses in either the test or control area exceeds 90, consult with those in charge of such equipment to set up procedures for tabulating the survey. If such equipment is not available or the number of responses in each area is small, hand tabulating is quite satisfactory.

Regardless of the tabulating procedure utilized, the completed questionnaires must be edited and coded. Editing should be done by persons other than those who conducted the interviews. The purpose of this task is to insure that all questions have been asked and answers recorded. Inconsistencies also can be identified and corrected.

On each questionnaire there should be a response to all appropriate questions. For example, if question 2 concerning people in the neighborhood complaining about pollution has been answered with a "Yes," then question 3 dealing with the kind of pollution people complain about should have also been answered, even if the answer is "Don't know."

The following comments regarding each question on the questionnaire may be used as a guide for editing. If editing uncovers errors or omissions, it may be necessary to call the respondent again to clarify an answer which has been incorrectly recorded or to eliminate an inconsistency.

Question 1. If the response is "No," all other questions on the questionnaire should be unanswered.

Question 2. If the response is "Yes," there should be an answer to question 3. If the response is "No," there should be no response to question 3.

Question 3. There should be no response to this question if question 2 has a "No" reply.

Question 4. If the response is "No" or "Don't know," questions 5, 6, 7, 8, 9, 10, and 11 should not contain responses. If the answer to question 4 is "Yes," questions 5, 6, 7, 8, 9, and 11 must have been answered, also, even if the answer is "Don't know."

Question 5. There should be a reply to this question only if question 4 was answered "Yes." If so, there must be a reply to this question.

Question 6. Same as question 5.

Question 7. Same as question 5.

Question 8. Same as question 5.

Question 9. Same as question 5.

Question 10. If the response to question 9 was "No" or "Don't know," there should be no response to this question. If the response to both question 4 and question 9 was "Yes," this question should have been answered, also.

Question 11. Same as question 5.

Question 12. There should be a response to this question on all questionnaires except those where the response to question 1 was "No."

Question 13. Same as question 12.

When the editing is completed, the questionnaires should be coded. This merely means writing the number of the response to each question on the appropriate line near the right-hand margin of the questionnaire. If there was more than one response to question 3, the number of each type of pollution mentioned may be written in the margin.

When the coding is completed, each questionnaire should be numbered on the first page in the blank following "Respondent No." The same sequence of numbers may be used for the test area and the control area, since the areas would be distinguished by the survey numbers assigned earlier.

Tabulation may be accomplished in one of two ways. A form can be designed on which to tally the number of responses of each kind to each question. (A recommended form is provided at the end of this procedure.) An alternative is to sort the questionnaires themselves into stacks according to the answers to a particular question and count the number of questionnaires in each stack. This method tends to be somewhat more error free than tallying.

Regardless of the method used, the total of all responses to each question (except question 3) must match the total number of people asked that question. This provides a check on the accuracy of the tabulation. (Since question 3 is a multiple response question, the total number of all responses may exceed the total number of people asked that question. Questionnaires containing more than one response to question 3 should be separated from those having only one response. Tabulate and total the responses on questionnaires having only one response. Then, tabulate separately the responses for each kind of pollution mentioned on the questionnaires with more than one response. Finally, add the two tabulations together to obtain the total number of responses for each kind of pollution included in question 3.)

For purposes of odor problem identification, it is not necessary to tabulate the responses to all questions. Question 1 is included in the survey to avoid errors caused by the use of street address telephone directories that may be as much as six months old. (Such directories are published at six-month intervals.) Questions 2 and 3 are included for introductory purposes. Questions 4 through 10 provide odor problem definition. Question 11 permits possible identification of the odor source. Questions 12 and 13 are included so that employees of the source under investigation may be removed from the sample.

All questions may be tabulated and will yield useful information, but for odor problem identification, tabulation should begin with question 9. The responses to question 9 alone will indicate whether an odor problem exists. If it is determined that an odor problem does not exist, complete tabulation of all questions need not be undertaken.

PROBLEM IDENTIFICATION

The decisive step in odor problem identification is to determine whether a significant difference exists between the proportion of respondents in the test area who state they have been bothered by odors and the proportion of respondents in the control area who state they have been bothered by odors. This is done by using the tabulated results of question 9 from the test area and control area surveys. A form entitled "Odor Problem Identification" is included at the end of this procedure to provide a convenient method for determining whether a significant difference exists. A technical explanation of the method is presented in the "Statistical Reference" section of this procedure.

If, after completing the "Odor Problem Identification" form, the number in the box labeled "z" is equal to or larger than 1.65, a significant difference exists between the test and control areas. If "z" is less than 1.65, no significant difference exists. If this analysis indicates no significant difference, then it should be concluded that the test area is not an odor problem area. If a significant difference is indicated, then an odor problem index number should be calculated to indicate the extent of the odor problem relative to other odor problems identified within the jurisdiction of the local agency. The odor problem index number may be simply constructed by completing a form entitled "Determination of the Odor Problem Index." This form is also included below. It is based on a formula given in the "Statistical Reference" section.

OTHER USES OF SURVEY RESULTS

During abatement proceedings, it may be necessary to refer to the results of the test area survey to indicate the percentage of test area residents who responded in a particular way. For example, it may be necessary to state the percentage of all test area residents who noticed odors in their neighborhood during the week of the survey. It would be inaccurate, however, to use directly the percentage of test area residents who answered "This week" to question 8. An adjustment is required to eliminate responses to question 8 that are actually based on variables other than odors.

The adjustment is easy to accomplish. Simply subtract the percentage response to the question in the control area from the percentage response in the test area. The answer is then divided by one hundred percent minus the percentage response in the control area. The resulting percentage is the true percentage response for the test area. Thus, if 65% of test area residents and 25% of control area residents stated they noticed odors in their neighborhoods "This week," then 53% would represent the true percentage of test area residents who actually noticed odors in their neighborhood during the week of the survey (65% - 25%/(100% - 25%) = 53%).

PUBLIC ATTITUDE SURVEY OF COMMUNITY ODOR PROBLEMS
PROBLEM IDENTIFICATION QUESTIONNAIRE

Respondent:

Phone No. ____________________

Street Address ____________________

City ____________________

File No. ______

Survey No. ______

Respondent No. ______

Record of Call:

Date	Time	Check If Interview Completed	Check If Interview Not Completed	Reason If Not Completed
______	______	( )	( )	______

"Hello. My name is ______(name)______. I'm calling (long distance) for a government agency interested in certain community problems. I'd like to talk with the man/lady of the house to get his/her opinion on a few questions. Are you the man/lady of the house?" (IF NOT, ASK: "May I talk with him/her?")

Q1) Have you lived at your present address more than six months?

____1. Yes

____2. No (SAY: "I'm sorry. This survey was designed for longer term residents. Thank you for your time.")

1______

Q2) Lately, people have become very much concerned about the environment and various types of pollution. Do people complain about any kind of pollution in your neighborhood?

____1. Yes (ASK Q3.)

____2. No (ASK Q4.)

____3. Don't know (ASK Q4.)

2______

Q3) Do people complain about...?

____1. Air pollution in your neighborhood

____2. Water pollution in your neighborhood

____3. Airport, industrial, or traffic noise in your neighborhood

3____

____4. Noticeable odors in your neighborhood

____5. Don't know (DO NOT READ THIS RESPONSE.)

Q4) Have you noticed any odors in your neighborhood in the last three months?

____1. Yes (ASK Q5.)

____2. No (SKIP TO Q12.)

4____

____3. Don't know (SKIP TO Q12.)

Q5) How often have you noticed these odors?

____1. At least once a day

____2. At least once a week, but not every day

____3. At least once a month, but not every week

5____

____4. Less than once a month

____5. Don't know

Q6) Generally speaking, how long do these odors last?

____1. At least one day

____2. At least one hour, but less than one day

____3. At least 15 minutes, but less than one hour

6____

____4. Less than 15 minutes

____5. Don't know

Q11) Where would you say most of these odors originate, that is, who or what causes them?

____1. Source(s) being investigated

____2. Other source(s): ______________________________

____

____3. Don't know

11 ____

"All this information is strictly confidential, but we need it for statistical purposes."

Q12) What company do you work for?

____1. Source(s) being investigated

____2. Other company/none: ______________________________

____

____3. Refused

12 ____

Q13) What companies do other members of your household work for?

____1. Source(s) being investigated

____2. Other company(ies)/none: ______________________________

____

____3. Refused

13 ____

"That completes the interview. Thank you very much for your time."

Interviewer's Name: ______________________________

Q7) How strong would you say these odors smell? Would you say...?

____1. Very strong

____2. Strong

____3. Moderate

____4. Slight

____5. Don't know (DO NOT READ THIS RESPONSE.)

7____

Q8) When was the last time you noticed odors in your neighborhood?

____1. This week

____2. Last week

____3. Two to four weeks ago/a month ago

____4. More than a month ago

____5. Don't know

8____

Q9) Would you say that these odors have bothered you?

____1. Yes (ASK Q10.)

____2. No (SKIP TO Q11.)

____3. Don't know (SKIP TO Q11.)

9____

Q10) How much would you say they have bothered you? Would you say...?

____1. Very much

____2. Much

____3. Moderately

____4. Little

____5. Don't know (DO NOT READ THIS RESPONSE.)

10____

PUBLIC ATTITUDE SURVEY - TABULATION FORM

File No. ______
Survey No. ______

Instructions. Place a tally mark in the appropriate box to record the answer to each completed question on the questionnaire. By tallying the fifth duplicate response with a diagonal line, counting total responses is simplified (卌 = 5 responses).

Question 1. (Tabulate only if desired)		
Response 1	Response 2	
Total Response 1	Total Response 2	Total

Question 2. (Tabulate only if desired)			
Response 1	Response 2	Response 3	
Total Response 1	Total Response 2	Total Response 3	Total

Question 3. (Tally all responses given on each questionnaire, if desired)					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 4.			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

Question 5.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

PUBLIC ATTITUDE SURVEY - TABULATION FORM (Continued)

File No. ______
Survey No. ______

Question 6.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 7.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 8.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 9.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 10.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

PUBLIC ATTITUDE SURVEY - TABULATION FORM (Continued)

File No. ______
Survey No. ______

Question 11. (Tabulate only if desired)			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

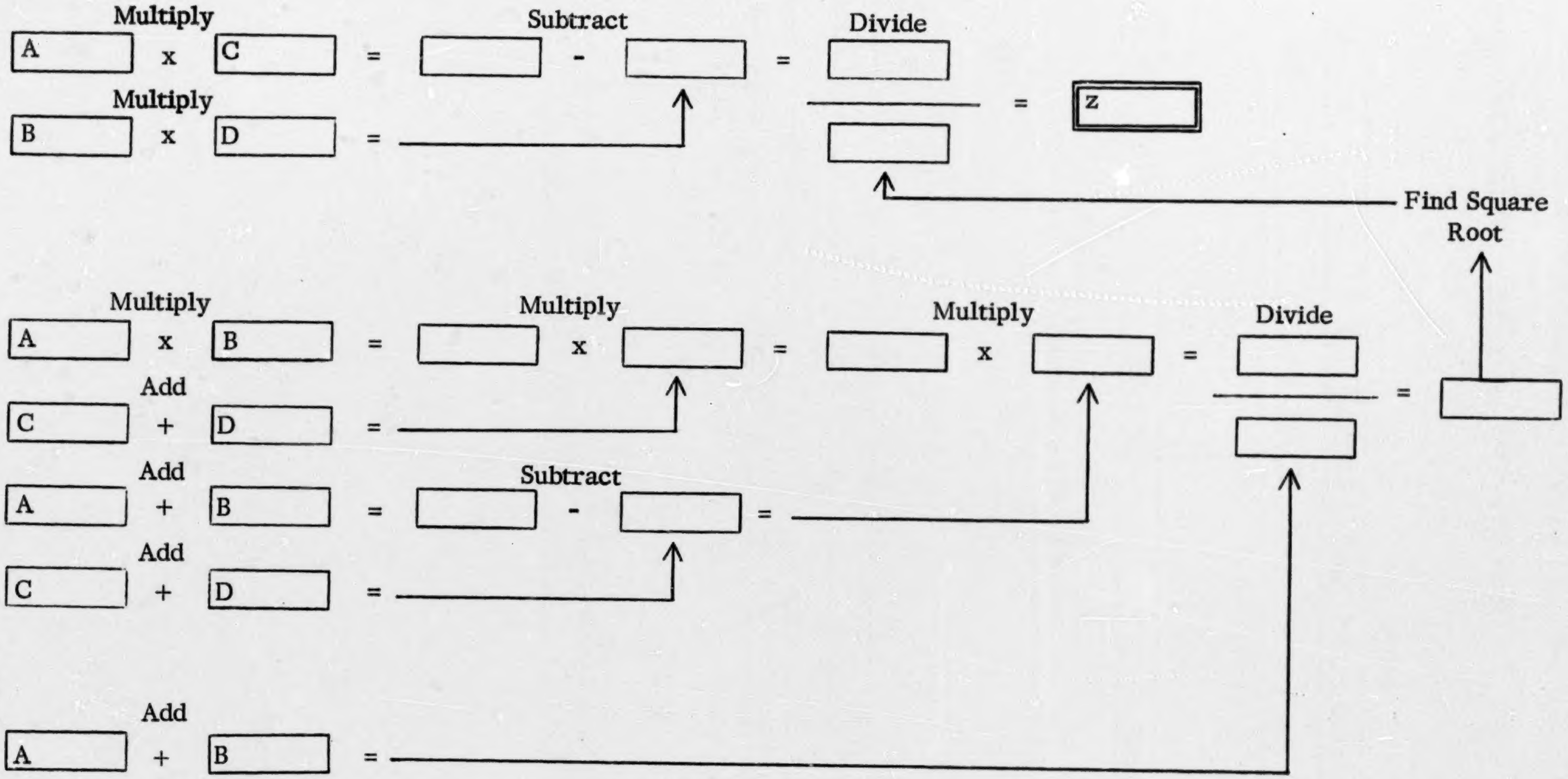
Question 12. (Tabulate only if desired)			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

Question 13. (Tabulate only if desired)			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

ODOR PROBLEM IDENTIFICATION

Instructions

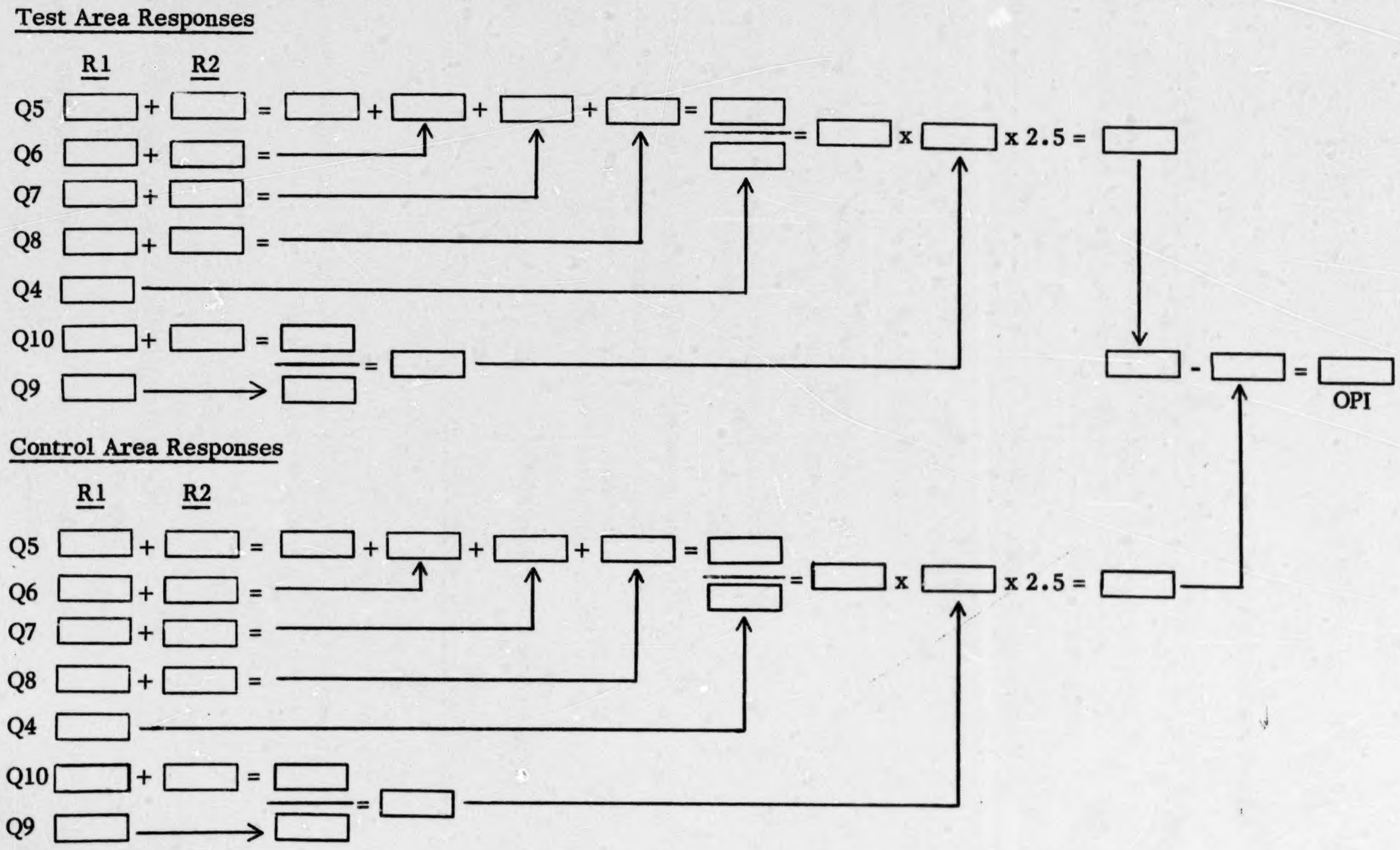
1. In each box labeled "A," fill in the number of interviews completed in the Control Area survey. (The number of interviews completed = the number of problem identification questionnaires checked as completed.)
2. In each box labeled "B," fill in the number of interviews completed in the Test Area survey.
3. In each box labeled "C," fill in the number of "Yes" responses (R 1) to Question 9 from the Test Area survey.
4. In each box labeled "D," fill in the number of "Yes" responses (R 1) to Question 9 from the Control Area survey.
5. Follow the direction of the arrows. Perform the calculations indicated. (The square root can be easily found by referring to a standard table of square roots and, therefore, need not be calculated.)
6. If the number in the box labeled "z" is 1.65 or more, an odor problem exists.


Multiply
A
x
C
=
Subtract
-
=
Divide
=
z
Multiply
B
x
D
=
Find Square Root
Multiply
A
x
B
=
Multiply
x
=
Multiply
x
=
Divide
=
Add
C
+
D
=
Add
A
+
B
=
Subtract
-
=
Add
C
+
D
=
Add
A
+
B
=

DETERMINATION OF THE ODOR PROBLEM INDEX

Instructions

Insert the total numbers of responses tabulated from the surveys in the boxes provided. Follow the direction of the arrows. Perform the calculations indicated. Round all decimal numbers to the nearest tenth.


Test Area Responses
R1
R2
Q5
Q6
Q7
Q8
Q4
Q10
Q9
+
=
x
x 2.5 =
-
OPI
Control Area Responses
R1
R2
Q5
Q6
Q7
Q8
Q4
Q10
Q9

STATISTICAL REFERENCE SECTION

Statistically Significant Differences for Odor Problem Identification

To determine whether there is a significant difference between the test and control area responses to question 9 of the Problem Identification Questionnaire, the following hypotheses must be tested:

Hypothesis 1 (H_1): $\pi_t = \pi_c$

Hypothesis 2 (H_2): $\pi_t > \pi_c$ (one-tail test)

$\alpha = 0.05$

where: π_t = the true or universe proportion of "Yes" responses to question 9 in the test area

π_c = the true or universe proportion of "Yes" responses to question 9 in the control area

α = the probability of concluding, on the basis of sample values, that no significant difference exists between test and control areas when a significant difference in universe values exists

Using the normal approximation:

$$(1) \quad z = \frac{(p_t - p_c) - (\pi_t - \pi_c)}{\sqrt{\frac{\pi_t(1 - \pi_t)}{n_t} + \frac{\pi_c(1 - \pi_c)}{n_c}}}$$

where: n_t = the sample size, i.e., the number of interviews completed in the test area

n_c = the sample size, i.e., the number of interviews completed in the control area

k_t = the number of "Yes" responses to question 9 in the test area

k_c = the number of "Yes" responses to question 9 in the control area

$$p_t = \frac{k_t}{n_t}$$

$$p_c = \frac{k_c}{n_c}$$

Assuming the null hypothesis is true, this equation becomes:

$$(2) \quad z = \frac{p_t - p_c}{\sqrt{\hat{\pi}(1 - \hat{\pi})(\frac{1}{n_t} + \frac{1}{n_c})}}$$

Estimating π by $\hat{\pi} = \frac{k_t + k_c}{n_t + n_c}$

and setting $N = n_t + n_c$

and $K = k_t + k_c$

then (2) can be rewritten as:

$$z = \frac{\frac{k_t}{n_t} - \frac{k_c}{n_c}}{\sqrt{\frac{K(N - K)}{N n_t n_c}}} = \frac{n_c k_t - n_t k_c}{\sqrt{\frac{n_t n_c K(N - K)}{N}}}$$

If z is normal, then the probability of $z \geq 1.65 = 4.95\%$ or approximately 5%.

Determination of the Odor Problem Index

$$OPI = 2.5 \left[\frac{(R1 + R2)_{Q5} + (R1 + R2)_{Q6} + (R1 + R2)_{Q7} + (R1 + R2)_{Q8}}{(R1)_{Q4}} \cdot \frac{(R1 + R2)_{Q10}}{(R1)_{Q9}} \right] \text{Test Area}$$

$$- 2.5 \left[\frac{(R1 + R2)_{Q5} + (R1 + R2)_{Q6} + (R1 + R2)_{Q7} + (R1 + R2)_{Q8}}{(R1)_{Q4}} \cdot \frac{(R1 + R2)_{Q10}}{(R1)_{Q9}} \right] \text{Control Area}$$

where: OPI = Odor Problem Index

R1 = response 1; R2 = response 2; etc.

Q1 = question 1; Q2 = question 2; etc.

The above formula is based on the Problem Identification Questionnaire. Assuming that the control area is as odor free as possible (at least as free of odors as the test area), the formula will yield an index number between zero and 10. The size of this number depends upon the combination of frequency (Q5), duration (Q6), intensity (Q7), and recentness (Q8) of odors noticed in the test area as compared to the control area. This combination of problem-inducing variables is weighted by the extent to which odors have caused bother in each area.

Adjustment to Eliminate Test Area Responses Based on Variables Other Than Odors

The formula is a Bayesian type of correction for chance success:

$$P'(S|s) = \frac{P(S|s) - P(S|n)}{100 - P(S|n)}$$

where: $P'(S|s)$ = the percentage of "signal" attributable to the variable under study

$P(S|s)$ = the total percentage of "noise" plus "signal" measured in the test group

$P(S|n)$ = the percentage of "noise" measured in the control group

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PROCEDURE FOR SOURCE VERIFICATION BASED ON SENSORY TECHNIQUES

INTRODUCTION

This procedure is designed to assist local agencies in source verification of identified odor problems. It describes the proper use of two sensory techniques, one using a Barnebey-Cheney Model I-3 Scentometer, the other employing an odor judgment panel trained to evaluate an odorized environment in terms of memorized reference standards. As implied below, the choice of techniques for use in a particular case depends upon the extent of information desired.

An odor judgment panel can be used not only to verify the source and areal extent of odors, but also to judge odor intensities concurrently at points throughout a test area. The size of an odor panel depends on the size of the test area and the transiency of the odors encountered. In general, the larger the test area or the more transient the odors, the larger must be the odor panel. In most cases, one panelist per city block would provide adequate coverage.

A scentometer can be used to measure ambient odor intensities while traveling through the test area. When odors are strong and constant, one scentometer may be adequate to cover a square mile or more. However, when odors are of low intensity and transient, one scentometer may be adequate to cover only a few city blocks.

WHEN TO USE THE SCENTOMETER

The scentometer is best suited for use in routine surveillance of chronic situations. It should be used to determine if odors can be detected above a specified dilution to threshold and, thereby, to indicate the locations of possible odor problems.

The scentometer could be used to assist a trained observer to verify the source of an identified odor problem. Specifically, it could be used:

(1) To establish a pattern of peak odor intensities, which may point to the source, while systematically traversing the test area in an automobile.

(2) To function as an odor free air chamber, and so, to refresh the trained observer whose ability to continuously sense the odor under investigation may otherwise be lessened due to fatigue.

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It is noted, however, that although the scentometer is always ready for immediate use in routine surveillance, it is not always applicable to source verification. This is because of the difficulty of obtaining readings when the odors encountered are transient.

WHEN TO USE AN ODOR JUDGMENT PANEL

An odor judgment panel should be used to verify the source of an identified odor problem if such verification cannot be established by a trained observer alone or by a trained observer using a scentometer. For source verification, an odor judgment panel can be used:

(1) To establish patterns of mean odor intensities and percentages of time odor was detected from concurrent evaluations at points throughout the test area.

(2) To judge the odor under investigation when odors of different qualities are encountered in the test area.

Such uses are possible only after lengthy selection and training processes necessary to ensure that the panelists can accurately relate to a series of reference standards.

THE SCENTOMETER

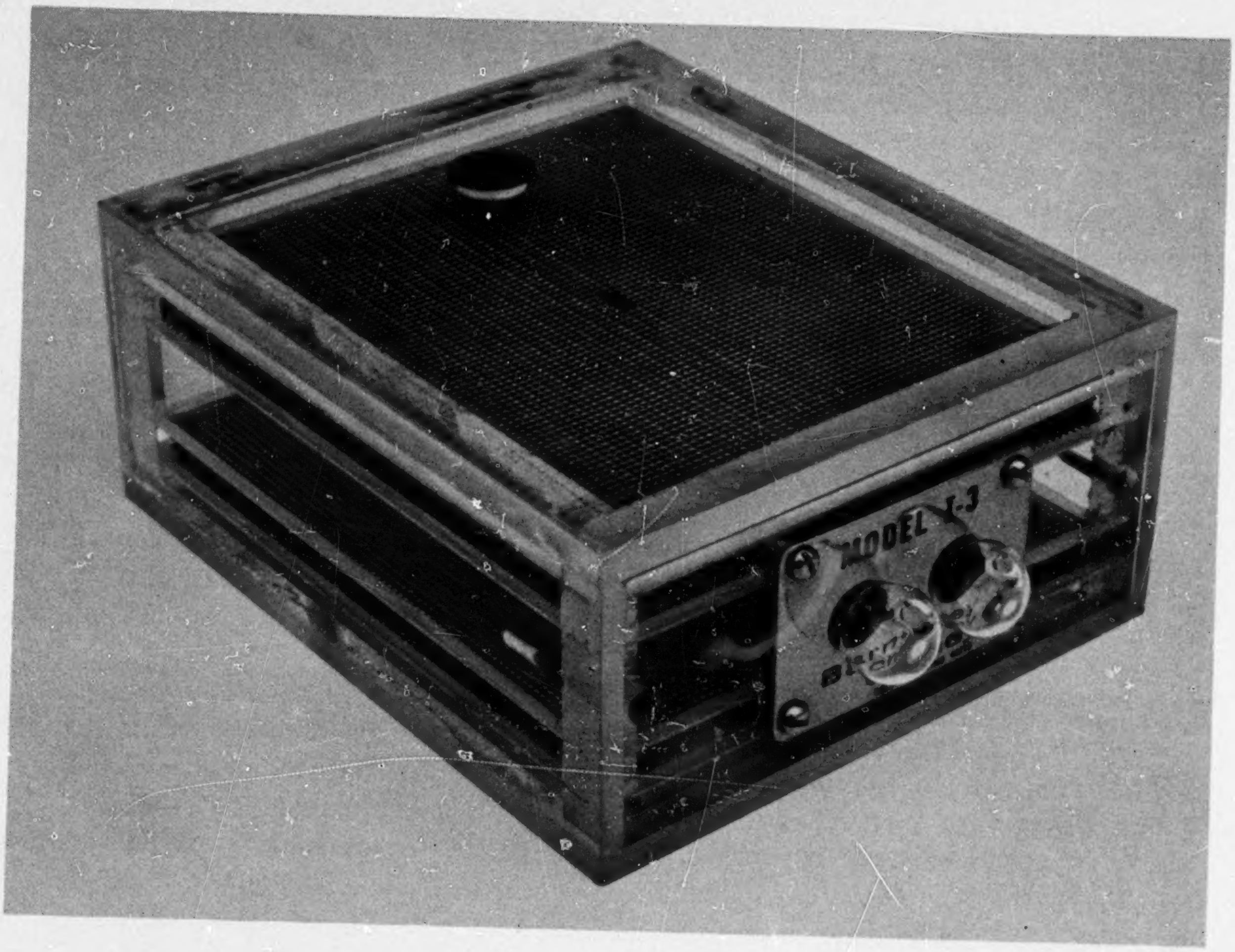
The scentometer (Figure 1) has been described by its developers and used by at least twelve local air quality agencies throughout the United States. Most of the descriptions have focused on the physical characteristics of the device and the principles of operation. Emphasis in this procedure is based on experience gained from actual use.

Preparation for Field Use

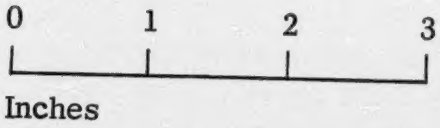
Before going into the field, the scentometer should be checked for proper function as follows: Tapes must be placed over the four dilution orifices in such a way that they can be pulled clear of the orifices and replaced repeatedly. It should be determined that all odors are absorbed by the charcoal beds. If necessary, fresh charcoal should be installed. Before each use, the scentometer should be shaken gently in a horizontal position to distribute the charcoal evenly over the beds, thereby eliminating the possibility of channeling.

The scentometer must be examined for leakage, especially around the two bulbs which fit to the operator's nostrils. If the bulbs are applied with pressure to the nostrils to avoid leakage, soreness can develop during constant

Figure 1. Barnebey-Cheney, Model I-3 Scentometer.



NOT REPRODUCIBLE


0
1
2
3
Inches

use in the field. If the bulbs are placed gently against the nostrils, leakage can result. Before and during measurements, the operator should check that no leakage of any type is occurring. This is done by using the scentometer in an area of strong odor after blocking the four orifices. No odor should be discernible.

Field Measurements

Before field measurements are attempted, the scentometer operator must first neutralize the effects of ambient odors by inhaling odorless air through the charcoal beds of the scentometer, while keeping the four orifices blocked. When this is accomplished, he should open the orifices of the scentometer in turn, until he can identify the smallest orifice through which odor can be detected.

It is noted that, while this technique is generally successful with strong and constant odors, very few readings may be obtained with low intensity and transient odors. Under the latter conditions, it is advantageous to use the scentometer while driving through a community. The application of this technique by a mobile operator is fairly simply and considerably more effective.

If odors are encountered in a community during routine surveillance, the intensities should be measured with the scentometer. Intensities detected at a particular dilution to threshold would indicate the location of a possible odor problem. After traversing the community several times, the operator should relax and breathe odor free air. This can be done by using the scentometer as an odor free chamber. However, it is more desirable to drive outside the test area, since it is difficult for the operator to relax with the scentometer bulbs pressed against the nostrils.

When the operator is suitably refreshed, the car is again driven through the affected area. Throughout this drive the operator breathes through the scentometer with a selected orifice open. The route then may be retraced with a different orifice uncovered, in order to further define the odor intensity. Each time the route is traversed, the operator calls out the points at which negative readings change to positive and vice versa. These points should be plotted on a map of the area or recorded on a form such as the "Scentometer Log Sheet" provided at the end of this procedure. It is possible to have four operators and a driver traverse the area in one car. With a different orifice open on each scentometer, a reading for any odor in the area can be quickly obtained.

This method, while more effective than scentometer readings taken at a fixed point, entails some problems. The automobile must be well ventilated and maneuverable. There must be two to five people in each car. If there are less than five people in a car, the success of the technique depends upon the constancy of the odor, since two or more trips through the area would be required to obtain readings through all of the orifices.

THE ODOR JUDGMENT PANEL

If a local agency wishes to perform odor judgment panel evaluations, panel members could be recruited from among the agency employees. This approach could reduce the urgency of preliminary activities and lower costs considerably, since panelist selection and training could be conducted at leisure at the agency facilities. It must be considered, however, that the results of evaluations by agency employees could be criticized as being biased against the source under investigation.

Regardless of this possibility, certain preliminary activities must be undertaken each time an odor judgment panel is to be used. These activities include determination of the size of the panel required, location of suitable stations (points in the test area at which panelists would be placed), location of a panel headquarters (if the agency facilities cannot be used), and preparation for transporting the panelists between the headquarters and the test area.

Preliminary Activities

The community in which an odor judgment panel is to be used should be visited to determine the areal extent of the odors to be investigated. It should be initially planned to provide one panelist for each city block affected by odors. If the test area is very large, the size of the panel must be determined by budgetary constraints. It is recommended that a minimum of twelve panelists be used for source verification in any case where public nuisance law is applicable.

The stations should be located in a systematic manner so that panel members are roughly equally spaced, with intervening distances not exceeding one city block (approximately 100 yards). Local odor interferences such as caused by automotive service garages, bakeries, or heavily traveled roadways should be avoided when selecting stations. Large scale maps of the test area should be used to plot all stations. Such maps should be sketched if none are available from commercial or governmental sources.

In addition to selecting stations, convenient locations for performing panel calibration tests must be found. These locations must be immediately downwind from an odor source, at places where the presence of large panel groups will not cause much disturbance in the neighborhood. Public parking lots, particularly for municipal golf courses and parks, work well.

The headquarters, which is the site used for testing, screening, training, and assembling, should be located close to the test area. The shorter the distance between these locations, the less the expense and proportion of daily schedule consumed in travel. However, one problem with having a headquarters close to the site is the possibility of leakage of information to the source under investigation. Depending upon secrecy requirements, it may be necessary to locate several miles distance from the site. Once in the test area, the presence of an odor panel is quickly noticed not only by residents, but possibly by employees of the facilities under investigation. Therefore, if secrecy is important, it may be desirable to use the panel for single days only, or for two or more randomly chosen days.

Transportation of the panelists to the test area can be by either cars or a bus. If a bus is used, all panelists may be transported together, and only one local agency representative is required to serve as driver. However, a significant amount of maneuvering is required in this work, and buses are not readily maneuverable. Cars are more maneuverable but, as the entire panel cannot be transported in one car, additional drivers are required. Cars are preferable as long as the area is known and several drivers are available, while a bus is preferable to a convoy of cars in a strange area.

To ensure proper selection, training, and deployment of panelists, one agency representative should be assigned to work with a maximum of six panelists. If such representatives would serve as drivers, the requirement for additional drivers is easily satisfied. Nine passenger station wagons provide an ideal compromise between buses and cars. With vehicles of this capacity, six panelists and their assigned agency representative can be transported together.

Recruiting Potential Panelists

If sufficient agency employees are not available for this work, it may be necessary to engage a professional survey firm to recruit panel members. It is preferable to select panel members with similar socio-economic characteristics to the residents of the test area, as although the panelists are asked only to relate the odor to standard intensities, bias may be introduced if panelists have a different background. If a panel is required for one week or less, college students and temporarily unemployed males are available, but if a panel is needed for longer periods or from time to time at regular intervals, housewives are usually the most available group.

Initial Selection of Panelists

After sufficient candidates have been recruited, the screening of potential panelists should be undertaken. Such screening is intended to exclude individuals with particularly insensitive or irrational responses to odors. Series of triangle tests are used initially to screen potential panelists. This method is quick, easy, and inexpensive to perform. The necessary equipment consists of a supply of 2-ounce paper cups, water, and odorous food extracts such as vanilla and wintergreen. The prospective panel members are given three cups to sniff and are instructed to specify the cup with the different odor. The three cups presented to the panelists may be one of the three following combinations:

(1) Two with the same odor, one with a different odor.
(2) Two with water (no odor), one with an odor.
(3) Two with the same odor, one with water (no odor).

It is best to begin this test using strongly scented samples detectable to everyone. The concentration of extract should be gradually decreased in water toward threshold levels. If the tests are conducted over several hours, breaks should be taken at regular intervals to avoid sensory fatigue. The test room should be well ventilated and odor free. Using an activated carbon room purifier unit, such as the Barnebey-Cheney Model ABB (4,000 cfm) or Model ADB (10,000 cfm), may be necessary to ensure an absence of ambient odor.

After each test involving all panelists, the scores should be reviewed to ascertain the percentage of correct answers. A range of correct answers should be chosen as a target, say 50% to 75%. If, for most prospective panelists, the actual percentage is outside this range, the concentration of odorants must be readjusted. When 6 to 9 tests have been completed, potential panelists should be accepted or rejected on the basis of their scores. An acceptance range of plus and minus two correct answers from the mean of the group is recommended.

Final Selection of Panelists

After the preliminary screening by triangle testing, training with reference standards is begun. A non-toxic, stable standard(s) should be chosen that closely matches the odor(s) to be encountered in the test area. Using various concentrations of this standard, the remaining candidates (now called "panelists") are trained to recognize the strengths of the odor with which they will be concerned. Any one of a variety of standards may be utilized. In a study of solvent emissions, for example, a methyl chloroform series may be used for degreasing process odors, a turpentine series for thinner odors, or an amyl acetate series for lacquer solvent odors. A panel recruited to observe rendering plant odors can be trained with ethanolamines. For refinery odors, reference standard solutions of tertiary dodecyl mercaptan are suitable.

The reference standard is dissolved in varying concentrations in an odorless solvent and numbered according to strengths. The number of strengths in a series may vary from 4 to 12, depending upon the range of odor intensities expeced to be encountered and the ability of the trained nose to differentiate between the strengths of adjacent solutions. As exemplified in Table 2, if the number of strengths in a series is limited to four, each solution might be four times more concentrated than the previous solution.

Table 2. Concentration of reference standard in odorless solvent used to simulate four strengths of the odor expected to be encountered in the test area.

Odor Intensity Rating	Concentration in Solvent (milliliters/liter)	Layman Assessment
1	0.125	slight
2	0.5	moderate
3	2	strong
4	8	very strong

The reference standards should be mixed ahead of time, although the undiluted odorant and solvent should be brought to the panel headquarters in case different or additional concentrations must be prepared.

Again, the test room should be well ventilated and odor free. The standards may be presented in capped, 4-ounce, polyethylene bottles with a polyethylent insert to minimize the possibility of leakage caused by shaking. Even with these bottles, however, napkins or paper towels should be kept on hand in case of spills.

Panelists should be instructed to shake the bottle gently once or twice, remove the cap, and squeeze the sides once as they hold the bottle under the nose. After a period of memorizing the different strengths and a few breaks to avoid fatigue, they should be encouraged to test themselves by removing a standard from the series at random and attempting to judge its intensity. At this time, the panel instructors should circulate about the room and test the panelists with unmarked samples. Prior to the training, a few sets of standards should be prepared on which the numbers are not clearly shown but are hidden on labels attached to the bottom of the bottles. All panelists should be asked to sniff one of these samples and judge the strength of the odor. Candidates' scores should be recorded and combined with the results of field calibration tests (described below) before the panel selection is finalized.

Instructions to Panelists

When the results of the reference standard tests indicate that the panelists are ready to go into the field, briefing on recording procedure is necessary. In addition, the following points should be stressed to them:

(1) All evaluation materials, including clipboards, rating sheets, and pencils, will be supplied by the local agency.

(2) A watch with a second hand and a large, easily read face is to be worn by each panelist.

(3) Appropriate clothing, including hats, coats, and gloves, is to be worn by each panelist if unfavorable weather is to be expected. (The work involves standing on streets. Cold wind and dampness, which may be present, can affect the efficiency of the unprepared panelist.)

(4) Smoking by panelists (and, particularly, by local agency representatives) is forbidden.

(5) Perfume and other strongly scented toiletries are not to be worn.

(6) Gum chewing and similar diversions by panelists are discouraged.

(7) The recognition of transient odors requires constant attention. Panelists must be as alert to the task as possible.

(8) Panelists must rate odors encountered in the test area in accordance with the strengths of the reference standards memorized in the test room.

All values should be recorded on an "Odor Intensity Rating Sheet," an example of which is included at the end of this procedure. How frequently values should be recorded depends upon the frequency, duration, constancy, and intensity of the odors. Normally, panelists should be asked to record the highest intensity present during each minute. The time recorded should reflect the end of each minute. For example: "Time: 10:40 a.m., Rating: 1" means that 1 was the highest intensity perceived between 10:39 a.m. and 10:40 a.m. Similarly, "Time: 3:45 p.m., Rating: 0" means that no odor was detected between 3:44 p.m. and 3:45 p.m.

Determining the "quality" of the odor perceived is often a problem, i.e., whether or not an odor encountered is that which bothers test area residents. Panelists should be instructed as follows:

(1) If the panelist is not sure whether the odor is like that used during training, he must record the odor intensity as well as possible and make a notation regarding odor quality.

(2) Only if the panelist is certain that the odor is foreign, i.e., if he can positively identify it as coming from some source

other than that under study) should he record a zero. Even in such a case, he should describe the quality of the odor perceived.

Calibration Tests

Uniformity of response among panelists must be monitored during both the training and field phases of the work. This is done by conducting field calibration tests, i.e., by having all panelists record data at one site. There should be a distance of at least two yards between panelists to ensure independent recordings. Any panelists who consistently records values significantly different from those of the majority should be rejected. Calibration tests actually serve two purposes. In addition to indicating the uniformity of the panelists' responses and, consequently, the reliability of the field values, they provide additional training and experience in the field.

Work Schedule

To get all panelists to work as a unit and, thereby, avoid those delays which result in reduced evaluation time in the test area, a rigid adherence to schedule is required. It has been observed that about one hour is the optimum time to leave a panelist on station. The panelist's concentration capabilities deteriorate significantly after working in solitude in one place for an hour. The type of schedule shown in Table 3 has been found to work well:

Table 3. Recommended work schedule.

Time Period	Activity
9:30 a.m.- 9:50 a.m.	Arrival of panelists, ready for departure
9:50 a.m.-10:10 a.m.	Travel to site, position panelists at first stations
10:10 a.m.-11:20 a.m.	Panelists record at first stations
11:20 a.m.-11:40 a.m.	Transfer to second stations
11:40 a.m.-12:50 p.m.	Panelists record at second stations
12:50 p.m.- 1:10 p.m.	Return to headquarters
1:10 p.m.- 2:10 p.m.	Lunch, restroom, etc.
2:10 p.m.- 2:20 p.m.	Short discussion, ready for departure
2:20 p.m.- 2:40 p.m.	Travel to site, position panelists at first stations
2:40 p.m.- 3:50 p.m.	Panelists record at first stations
3:50 p.m.- 4:10 p.m.	Transfer to second stations
4:10 p.m.- 5:20 p.m.	Panelists record at second stations
5:20 p.m.- 5:40 p.m.	Return to headquarters
5:40 p.m.- 5:45 p.m.	Dismissal of panelists
Total time evaluating odors	4-3/4 hours
Total time working	7-1/4 hours
Total time on break	1 hour
Total time per day	8-1/4 hours

Panel calibration tests can be incorporated into the schedule by reducing the 1 hour and 10 minute periods allocated to panelists at individual stations. Normally, one 10 minute calibration test in the morning and another of equal duration in the afternoon is sufficient to monitor uniformity of response.

General Observations

Based on the results of the use of odor judgment panels during the national survey of the odor problem and the study of the social and economic impact of odors, some observations are offered for local agency consideration.

(1) In general, women seem more emotionally involved than men and, therefore, appear less detached and specific.

(2) Some panelists become very anxious during calibration runs, whereas they are relaxed when alone during actual field measurements.

(3) Some panelists have difficulty in concentrating if left alone for long periods, and start talking to passers-by, listening to radios, etc. Some discipline is required.

(4) Panelists should be instructed to try to avoid direct questions from passers-by and, if necessary, should indicate that they are surveying cars or other objects unrelated to odors. Some are able to be convincing without difficulty, while others may have trouble.

(5) Panelists are sometimes questioned by police. It is therefore necessary to inform the local police of the field schedule before the evaluations take place.

SOURCE VERIFICATION

The data recorded by individual panelists can be summarized by panelist and by station. (Based on the recommended work schedule, as many as four panelists per day could be assigned to the same station.) Since the relative ability of each panelist to the panel as a whole may be estimated by use of the calibration tests, the most appropriate summary is by stations.

Psychologists generally prefer the use of median values as a measure of central tendency of data generated by human evaluation. But, because of the typically skewed distribution of odor intensity ratings by odor judgment panelists (particularly when odors are transient, many "no odor" ratings are listed), the mean values recorded at each station are recommended for summary purposes.

A form entitled "Odor Intensity Rating Summary Sheet" is provided at the conclusion of this procedure for the convenience of local agency personnel in preparing summary information.

A summary of odor judgment panel data can be used to plot odor intensity isopleths for the test area investigated. Such isopleths may show mean odor intensities or the percentages of time that odor was detected. Examples of typical isopleths are shown in Figures 2 and 3. By plotting isopleths, studying recorded wind data for the periods of panel evaluation, and noting the topographical features of the test area, the odor source usually can be verified with confidence and a pattern of odor intensity levels throughout the test area can be established.

Figure 2. Example of isopleths representing mean odor intensities recorded by odor judgment panelists stationed in a test area at the points indicated.

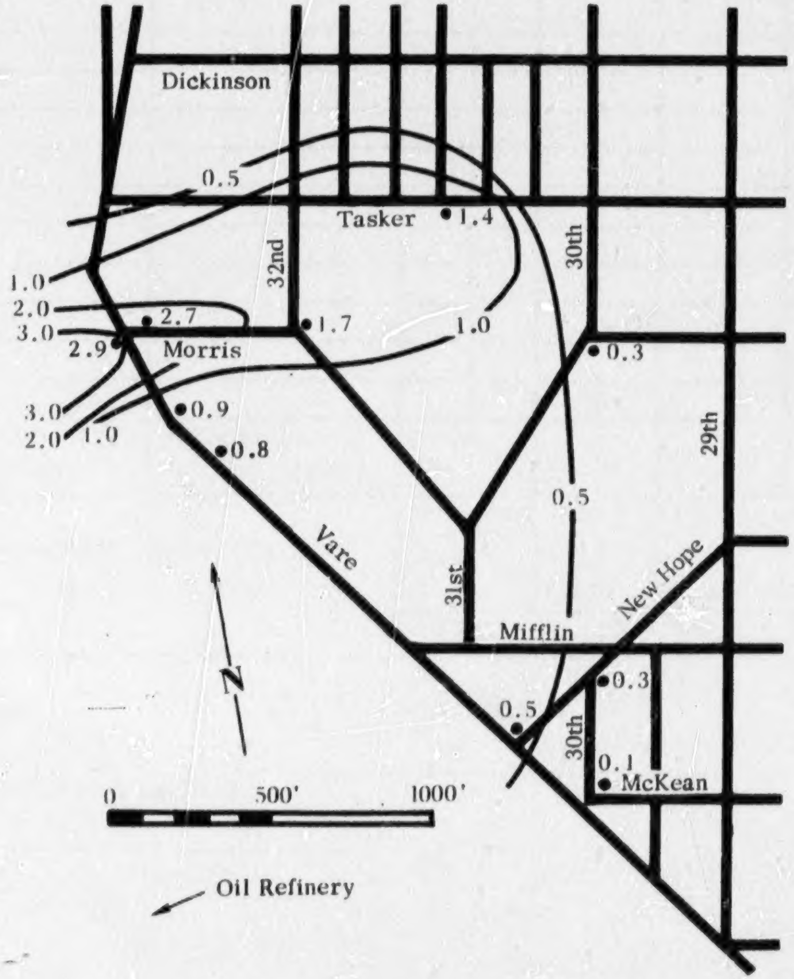
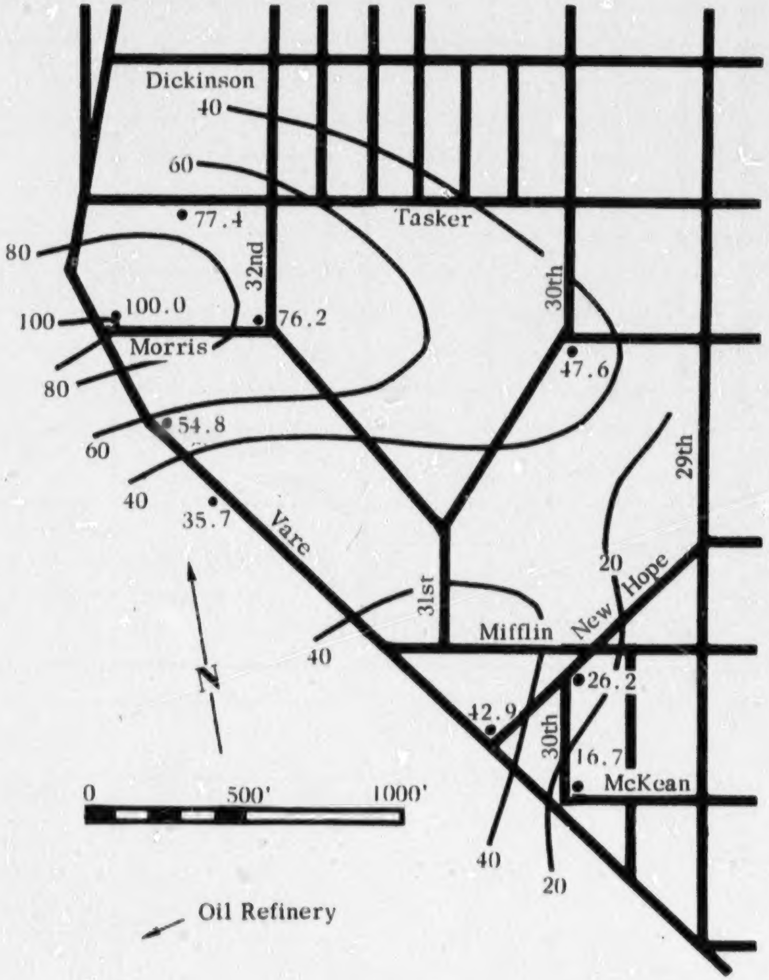

Dickinson
Tasker
Morris
Mifflin
McKean
Vare
New Hope
32nd
30th
31st
29th
30th
0.5
1.4
1.0
2.0
3.0
2.7
2.9
1.7
1.0
0.3
3.0
2.0
1.0
0.9
0.8
0.5
0.3
0.5
0.1
N
0
500'
1000'
Oil Refinery

Figure 3. Example of isopleths representing percentages of time odor was detected by odor judgment panelists stationed in a test area at the points indicated.


Dickinson
40
60
Tasker
77.4
80
100
100.0
76.2
Morris
80
47.6
54.8
60
40
35.7
Vare
32nd
30th
31st
29th
20
New Hope
Mifflin
40
26.2
42.9
30th
16.7
McKean
40
20
N
0
500'
1000'
Oil Refinery

File No. ____________ SCENTOMETER LOG SHEET Date ____________

Community(s) Affected ____________ Odor Source(s) ____________

Operator 1 ____________ Operator 2 ____________ Operator 3 ____________ Operator 4 ____________

Points at Which Readings Were Taken		Operator No. and D/T Setting								Points at Which Readings Were Taken		Operator No. and D/T Setting							
		Opr: D/T:		Opr: D/T:		Opr: D/T:		Opr: D/T:				Opr: D/T:		Opr: D/T:		Opr: D/T:		Opr: D/T:	
		Time and Reading (+ or -)										Time and Reading (+ or -)							
Street Traveled	Cross Street or Landmark	T	R	T	R	T	R	T	R	Street Traveled	Cross Street or Landmark	T	R	T	R	T	R	T	R

ODOR INTENSITY RATING SHEET

NAME____________________ DATE____________________

LOCATION____________________ LOCATION____________________

TIME	RATING	COMMENTS	TIME	RATING	COMMENTS

ODOR INTENSITY RATING SUMMARY SHEET

Panelist Location (Station)	Percent Time Detected and Mean Odor Intensity																			
	Date:				Date:				Date:				Date:				Date:			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M

PROCEDURE FOR PROBLEM ASSESSMENT

INTRODUCTION

Tentative methods of problem assessment are contained in the final report, "A Study of the Social and Economic Impact of Odors, Phase II." The principal economic effect of odors can be measured in terms of property value differentials, especially residential property value differentials. A description of the data required and analysis employed in this aspect of problem assessment is presented in Chapter VI. An effects determination questionnaire was developed to determine how residents feel odors have affected themselves, their families, and their properties. Property values, living patterns, and health symptoms are covered. A description of the questionnaire and its use is included in Chapter VII.

WHEN TO ATTEMPT PROBLEM ASSESSMENT

The most common effect of odors — annoyance — is readily measured using the procedure for problem identification. Based on results of the above mentioned study, economic and other social effects are measurable only in an extremely chronic situation. Such a situation may be presumed to exist if more than 50 percent of the test area residents interviewed, using the problem identification questionnaire, state they have been bothered "Very much" by odors in their community (question 10, response 1).

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APPENDIX

ESTIMATES OF COSTS INCURRED FROM USING PROCEDURES

Estimates of the costs of services and materials necessary for problem identification and source verification are listed below by task and cost category. Where possible, these estimates are based on 1971 prices averaged for the United States as a whole. Consequently, they may differ somewhat from actual costs incurred in a particular metropolitan area.

Local agency labor requirements are listed in terms of mandays only. Daily rates must be applied by agency officials.

Public Attitude Survey Costs

The estimates given in this section represent the costs of conducting identical public attitude surveys in one test area and one control area.

Task/Category	Estimated Cost	
	Unit	Total
Task I: Select Test and Control Areas		
Supervisory time	1 manday/area	2 mandays
Clerical time	1 manday/area	2 mandays
Purchase of U. S. Census of Population and Housing Census Tract Reports (first survey only)	$5	$5
Purchase of census tract maps for agency's jurisdiction (first survey only; necessary only if maps are not included in U. S. Census of Population and Housing Census Tract Reports	$15	$15
Task II-A: Select Telephone Numbers for Samples		
Clerical time	1 manday/area	2 mandays
Rental of street address telephone directories (for usual six month period)	$50/directory/area	$100

Task/Category	Estimated Cost	
	Unit	Total
Task II-B: Conduct Interviews		
Supervisory time (first survey only)	1 manday	1 manday
Clerical time:		
Training (first survey only)	2 mandays	2 mandays
Interviewing	2 mandays/area	4 mandays
Reproduction of questionnaires	120 questionnaires @ $0.20/questionnaire	$24
Telephone toll charges (if applicable)	60 calls/area @ $0.25/call	$30
Task II (Alternative): Select Sample and Conduct Interviews		
Reproduction of questionnaires	120 questionnaires @ $0.20/questionnaire	$24
Professional survey firm charges:		
Select sample	$50/sample/area	$100
Conduct interviews	60 interviews/area @ $3.50/interview	$420
Telephone toll charges (if applicable)	60 calls/area @ $0.25/call	$30
Task III: Edit Questionnaires		
Clerical time	0.5 manday/area	1 manday
Task IV: Code Questionnaires		
Clerical time	0.5 manday/area	1 manday
Task V: Tabulate Responses		
Clerical time	2 mandays/area	4 mandays
Reproduction of tabulation forms	120 forms @ $0.15/form	$18
Task VI: Evaluate Survey Results		
Supervisory time	1 manday	1 manday
Clerical time	1 manday	1 manday

Task/Category	Estimated Cost	
	Unit	Total
Estimated Total Costs (Task II Performed By Agency)		
First set of surveys:		
Supervisory time		4 mandays
Clerical time		17 mandays
Services and materials		$192
Each additional set of surveys:		
Supervisory time		3 mandays
Clerical time		15 mandays
Services and materials		$172
Estimated Total Costs (Task II Performed By Professional Survey Firm)		
First set of surveys:		
Supervisory time		3 mandays
Clerical time		9 mandays
Services and materials		$612
Each additional set of surveys:		
Supervisory time		3 mandays
Clerical time		9 mandays
Services and materials		$592

Scentometer Measurement Costs

The following estimates represent the use of a scentometer in routine surveillance for one day.

Task/Category	Estimated Cost	
	Unit	Total
Task I: Prepare for Field Use		
Purchase of Barnebey-Cheney Model I-3 Scentometer (first use only)	$85	$85
Task II: Conduct Field Measurements		
Technician time:		
Scentometer operator	1 manday	1 manday
Driver	1 manday	1 manday
Agency vehicle use	200 miles @ $0.12/ mile	$24

Task/Category	Estimated Cost Unit	Estimated Cost Total
Task III: Evaluate Measurements		
Supervisory time	0.5 manday	0.5 manday
Estimated Total Costs		
First use:		
Supervisory time		0.5 manday
Technician time		2 mandays
Materials		$109
Each additional use:		
Supervisory time		0.5 manday
Technician time		2 mandays
Materials		$24

Odor Judgment Panel Costs

The estimates provided below include the costs of selecting, training, and using twelve odor judgment panelists for source verification in one test area.

Task/Category	Estimated Cost Unit	Estimated Cost Total
Task I: Preliminary Activities		
Supervisory time	1 manday	1 manday
Agency vehicle use	100 miles @ $0.12/ mile	$12
Task II: Screen Candidates		
Supervisory time	1 manday	1 manday
Technician time	1 manday	1 manday
Rental of odor free room	$25/day	$25
Purchase of Barnebey-Cheney Model ABB Activated Carbon Room Purifier Unit (first use only)	$480	$480
Purchase of food extracts, mixing bottles, and cups	$10	$10
Payments to candidates (successful candidates only)	12 candidates @ $20/ candidate	$240

Task/Category	Estimated Cost	
	Unit	Total
Task III: Train Panelists		
Supervisory time	1 manday	1 manday
Technician time	1 manday	1 manday
Rental of odor free room	$25/day	$25
Purchase of odorant, solvents, mixing bottles, plastic bottles	$50	$50
Payments to panelists	12 panelists @ $20/ panelist	$240
Task IV: Perform Field Evaluations		
Supervisory time	1 manday	1 manday
Technician time	1 manday	1 manday
Rental of station wagons	2 station wagons @ $17/day plus $0.17/mile (200 miles)	$68
Reproduction of rating forms	80 forms @ $0.05/ form	$4
Payments to panelists	12 panelists @ $20/ panelist	$240
Task V: Summarize Field Evaluations		
Supervisory time	1 manday	1 manday
Technician time	2 mandays	2 mandays
Estimated Panel Preparation Costs		
First panel:		
Supervisory time		3 mandays
Technician time		2 mandays
Services and materials		$1,082
Each additional panel:		
Supervisory time		3 mandays
Technician time		2 mandays
Services and materials		$602
Estimated (Daily) Field Evaluation Costs		
Supervisory time		2 mandays
Technician time		3 mandays
Services and materials		$312

SUGGESTED REFERENCES

Census Tract Data

U. S. Bureau of the Census. U. S. Censuses of Population and Housing: 1960. Census Tracts. Washington, D.C.: U. S. Government Printing 1962.

Census tract data for use by each local agency are recorded in one of a series of reports under the above title. The Bureau of the Census should be contacted to determine the report number for the agency's jurisdiction. Census tract data for 1970 should be available in similar form in early 1972. Census tract maps are included with these reports.

Odor Judgment Panel Information

Wittes, Janet, and Turk, Amos. "The Selection of Judges for Odor Discrimination Panels," Correlation of Subjective-Objective Methods in the Study of Odors and Taste. Special Technical Publication No. 440, American Society for Testing and Materials, 1968.

This comprehensive discussion of the use and analysis of screening tests was co-authored by Amos Turk, the originator of the odor judgment panel technique.

Scentometer Information

Huey, Norman A., Broering, Louis C., Jutze, George A., and Gurber, Charles W. "Objective Odor Pollution Control Investigations," Journal of the Air Pollution Control Association, X, No. 6 (December, 1960), 441-446.

This article, by the developers of the scentometer, provides the most comprehensive description available of the physical characteristics of the device and the principles of operation.

Statistical Tables

Mathematical Tables From Handbook of Chemistry and Physics. Cleveland, Ohio: Chemical Rubber Publishing Company, any edition.

Tables of square roots, needed for Odor Problem Identification (see page 24), and other values are included in this mathematical section of the widely used handbook.